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AN INTERNATIONAL MONTHLY JOU
ON DISEASES OF THE

EAR-NOSE-THRO

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DR. M A GOLDSTEIN, ST LOUIS

VOLUME LXV—January-December, 19

DR. THEO E WALSH, ST LOUIS
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SPEECH DISCRIMINATION IN CENTRA AUDITORY LESIONS*

THEO E WALSH M D.,
and
ALLAN GOODMAN, Ph D.,
St Louis, Mo

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SPEECH DISCRIMINATION IN CENTRAL AUDITORY LESIONS*

THEO E WALSH, M D ,
and
ALLAN GOODMAN, Ph D ,
St. Louis, Mo

It has been suggested recently that the relation between the discrimination score and the threshold loss of hearing for speech might aid in the diagnosis between cochlear lesions and those of the auditory tract central to the end organ

Dix, Hallpike and Hood[1] stated that in cases of tumor of the VIIIth Nerve intelligibility for speech increased with amplification whereas the opposite was true in cases of cochlear hydrops Eby and Williams reported five cases of VIIIth Nerve tumors which seemed to justify the conclusions of Dix, *et al*, and one of us (T E W)[3] suggested that the relation of the threshold loss for speech to the discrimination score might be a differential diagnostic point between end organ and central lesions

Lidén,[4] on the other hand, in a study with Swedish language material, reporting on seven tumors, stated that All of the tumor cases showed conspicuously poor discrimination, the articulation score usually being worse than might have been supposed from the pure tone audiogram "

Schuknecht and Woellner[5] reported two cases of VIIIth Nerve tumors which showed a moderate threshold loss with very poor discrimination.

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It is our purpose in this communication to report four cases with central lesions which demonstrate findings in support of Liden's and Schuknecht's experiences

EQUIPMENT AND PROCEDURES

Thresholds for pure tones were measured with an ADC-Microtone Type 53-C audiometer fitted with Permoflux (PDR-10) earphones and calibrated in accordance with the American Standard Specification for Audiometers (ASA Z24 5-1951) The results in all cases are expressed in decibels relative to normal hearing The procedure for measuring the pure-tone threshold was a standard clinical one in which the tone was interrupted manually, and the threshold was approached both from above and below at least three times

The masking source was a white noise with a uniform spectrum in the band 20-7000 cps The level of masking used in any given instance is expressed in overall sound pressure level (db above 0 0002 microbar)

Hearing loss for speech was measured with CID Auditory Test W-2, a set of recordings of English spondaic words, the intensity of which decreases automatically on the record The hearing loss for speech is expressed in each case as the difference in decibels between the intensity required by the patient and the intensity required by a normal listener to repeat correctly 50 per cent of such words

Speech discrimination scores were obtained by presenting recorded PB lists (Rush Hughes PB-50 Auditory test), each consisting of 50 difficult monosyllabic words, at a level 40 db or more above the patient's threshold for speech This is sufficient to establish a PB maximum score The speech discrimination score is expressed in per cent words correctly repeated The sound-pressure-level in db (re 0 0002 microbar) at which each PB test was given is indicated

Recruitment was explored with an alternate binaural loudness balance method The loudness was balanced at sensation levels of 20, 40, 60, 70, 80 db, etc , and at each sensation level from three to five judgments of equal loudness were obtained for both ascending and descending approaches The patient listened to as many pairs of tones as he wished before judging the tones as same or different For these measurements, as for the diplacusis measurements, the equipment employed consisted of a two-channel electronic switch with one channel fed by a General Radio Beat-Frequency Oscillator (713 B), and the other by a Hewlett Packard Audio Oscillator (Model 200 BR) Control attenuators and two Permoflux (PDR-10) earphones completed the equipment In the cases defined as non recruiting, the sound pressure-level difference at the high sensation levels was approximately equal to the difference at threshold

Case 1 L. B white female age 34 was seen by the department of Neurosurgery presenting a two-year history of decreased hearing in the left ear a one-year history of staggering gait and several months history of numbness on the right side of the face Nystagmus was observed on either lateral gaze there were left cerebellar signs, bilateral papilledema, right facial weakness and a diminished right corneal reflex. X ray studies were negative.

Audiometric Data

Frequency	250	500	1000	2000	3000	4000	6000	8000
Right air	–5	–5	10	5	5	0	10	5
Left, air	60	65	65	45	40	50	40	40
bone		40	50 ↓	50 ↓	35	50 ↓		

	Hearing Loss for Speech	Speech Discrimination
Right	11 db	86% at 90 db SPL

For the left ear speech at 120 db SPL with 90 db masking in the opposite ear was unintelligible. The patient could hear something but she could understand nothing She commented It sounds loud but I cannot understand it. It all sounds the same It s not so loud as the right ear (90 db) There was no recruitment at 3000 cps Diplacusis was observed with 2300 to 2500 cps on the left ear judged equal in pitch to 3000 cps on the right ear The left pure-tone thresholds air and bone were measured with 90 db masking in the right ear

Operative Data

The left cerebellopontine angle was explored there was a large tumor lying in the region of the VIIIth Nerve which extended up to the tentorium and also extended down along the margins of the IXth Xth and XIth Nerve complex almost to the foramen magnum It extended up to the tentorium and into the incisura and it extended around anteriorly almost to the opposite side of the pons There was a nubbin of tumor in the internal auditory canal. The final diagnosis was left VIIIth Nerve neurilemmoma.

Case 2 D H white male age 54 was seen by the department of Neurosurgery Six years prior to examination following influenza the patient had a first episode of dizziness and staggering gait accompanied by sudden onset of tinnitus and loss of hearing in the right ear The dizziness and staggering gait cleared in approximately two weeks but the tinnitus and hearing loss persisted There had been occasional intermittent episodes of vertigo and headache since then Three months prior to examination the patient experienced a recurrence of staggering gait and severe right headache which extended from the occiput to the angle of the right mandible The headaches were aggravated by sudden movements of the head The vertigo was initiated or aggravated by sudden movement of the head and accentuated by emotional stress Bilateral papilledema was observed There was nystagmus on right lateral gaze, a diminished right corneal reflex and a right facial weakness Ice water caloric showed a very faint response on the right with an active response on the left X rays were negative

Audiometric Data

Frequency	250	500	1000	2000	3000	4000	6000	8000
Right, air	80	85	80	75	80	80	80↓	80↓
bone		50↓	50↓	50↓	50↓	50↓		
Left, air	0	10	15	10	20	20	15	5
bone		10	10	25	25	20		

	Hearing Loss for Speech	Speech Discrimination
Left	20 db	84% at 90 db SPL

For the right ear speech at 120 db SPL with 100 db masking in the opposite ear was unintelligible The patient complained of headache, and although he was cooperative he was not thoroughly convinced of the value of the tests since he felt that his right ear was not functioning at all There was no diplacusis and no recruitment in the right ear at 2000 cps The right pure-tone thresholds air and bone were measured with 100 db masking in the left ear

Operative Data

" removal of a very large VIIIth Nerve tumor on the right The tumor extended from below the XIth Nerve rostrally into the incisura and laterally into a moderately dilated internal auditory canal It had a broad based attachment against the brain stem The tumor involved the entire cerebello pontine angle The final diagnosis was right VIIIth Nerve neurilemmoma.

Case 3 L R white male, age 54, was first seen by one of us (T E W) complaining of dizzy spells loss of hearing and tinnitus in the left ear The tinnitus was described as a 'roar' or buzz He also reported severe headaches from time to time Tinnitus was first noted five years prior to his examination here and three years prior to examination he noticed a loss of hearing in the left ear Attacks of vertigo had occurred two years and again nine months prior to examination both of these attacks being severe For the two months previous to his examination he had had frequent dizzy spells, and these had increased in severity The responses to hot and cold water were about equal for the two ears X rays showed no abnormalities His EEG demonstrated a very mild mixed dysrhythmia The spinal fluid protein was elevated (41 mg per cent) The patient was referred to the Department of Neurosurgery

Audiometric Data
3/10/53

Frequency	250	500	1000	2000	3000	4000	6000	8000
Right, air	10	15	10	5	45	55	65	55
bone		15	0	10	45	50↓		
Left air	40	35	40	55	55	65	75	80
bone		40	35	50↓	50↓	50↓		

	Hearing Loss for Speech	Speech Discrimination
Right	15 db	84% at 90 db SPL 82% at 90 db SPL
Left	47 db	44% at 90 db SPL 40% at 120 db SPL

A left partial recruitment was measured for 2000 cps in which a 50 db difference at threshold was reduced to a 20 db difference at 80 db above threshold. A diplacusis was observed in which 2000 cps on the right ear was judged equal to 1550 to 1700 cps on the left ear The right bone and the left air and bone pure-tone thresholds were measured with 90 db masking in the opposite ear The left speech discrimination scores were measured with 70 and 100 db masking respectively

4/9/53	Hearing Loss for Speech	Speech Discrimination
Right	14 db	78% at 90 db SPL
Left	64 db	0 at 120 db SPL 0 at 100 db SPL

The left speech threshold was measured with 80 db masking The left speech discrimination scores were measured with 100 and with 80 db masking respectively

Audiometric Data
4/17/53

Frequency	250	500	1000	2000	3000	4000	6000	8000
Right air	15	10	5	5	50	55	75	65
bone		15	0	15	50↓	50↓		
Left air	70	65	65	60	60	65	70	80
bone		35	50↓	50↓	50↓	50↓		

	Hearing Loss for Speech	Speech Discrimination
Right	12 db	84% at 90 db SPL
Left	68 db	8% at 120 db SPL 2% at 110 db SPL

There was a left partial recruitment at 2000 cps a 55 db difference at threshold being reduced to a 26 db difference at 70 db above threshold Sensation of pitch was different in the two ears 2000 cps in the right was judged equal to 1950 to 2020 cps in the left and was described as shrill" in the left. The patient commented regarding the PB s on the left ear at 110 db SPL Some come through clear but most of them just seem to hit the ear and bounce back—all in a jumble—they run together They sound about as loud as on the other ear (90 db) " The bone conduction pure-tone thresholds were measured with 90 db masking, the left air conduction thresholds with 100 db masking, the left speech threshold with 80 db masking and the left discrimination scores were obtained with 100 and 90 db masking, respectively

Operative Data

"Overlying the medial third of the VIIIth Nerve and internal auditory artery was an exuberant mass of choroid plexus, evidently arising from the lateral recess, which was larger than normal and which seemed to be stuck down to the medial portion of the VIIIth Nerve and the auditory artery Whether this in itself accounted for the patient's symptoms or not, I cannot say, but I am inclined to be somewhat suspicious I could see no other evidence of abnormality I debated whether to attempt to coagulate the redundant mass of choroid plexus and thus determine whether the patient's symptomatology was due to this alone, however, taking into consideration the patient's personality plus the fact that he had no serviceable hearing I felt constrained to make certain of the results of this operation and, therefore, proceeded to section the VIIIth Nerve At the time of discharge the patient was alert, oriented and able to walk without difficulty, there was no nystagmus The only neurologic deficit was left nerve deafness "

Case 4 G G, white female, age 37, was seen by the department of Neurosurgery Three years prior to examination the patient experienced difficulty in controlling her right leg and arm in walking and eating At about the same time she experienced her first attack of vertigo in which the environment seemed to move She felt better with her eyes closed At the same time she also experienced diplopia and headache, which extended from the back of her head down to the neck right and left. The headaches, motor difficulty and diplopia were intermittent. The vertiginous attacks occurred about twice a month, the last bad attack a year and a half prior to examination and a milder attack about two and a half weeks prior About two and a half weeks preceding examination, the patient noticed a right ear hearing loss and claimed that her right ear felt "closed off some" The right side of her face and the right side of her tongue became numb a few days later There was no complaint of tinnitus There was spontaneous nystagmus on either lateral gaze (more marked to the right) and on upward gaze Calorics showed a right directional preponderance and a right hyperactive response.

Audiometric Data

Frequency	250	500	1000	2000	3000	4000	6000	8000
Right, air	0	5	20	20	35	35	15	20
bone		10	25	25	20	40		
Left, air	–5	–5	0	–5	10	–5	15	5

	Hearing Loss for Speech	Speech Discrimination
Right	7 db	54% at 90 db SPL 58% at 90 db SPL
Left	2 db	88% at 90 db SPL

Recruitment was absent for the right ear at 1000 and at 4000 cps There was an 8 to 12 db spread for equal loudness judgments at each sensation level. For the pitch judgments, 1000 cps in the left was judged equal to 900 and 1000 cps in the right, and 4000 cps in the left was judged equal to 4200 and 4300 cps in the right. The patient commented that the PB s were clearer in the left ear that 1000 and 4000 cps were clear in the left ear but were a buzz in the right ear—too much of a buzz, particularly for 4000 cps to be at all sure of pitch equality with the tone in the left ear The right bone and air conduction thresholds were measured with 90 db masking in the left ear The air conduction thresholds were the same with and without masking.

Impression Multiple sclerosis?

DISCUSSION

It is of central interest that speech discrimination in these cases is remarkably poor in relation to the threshold loss, and that this obtains in the absence of recruitment Case 4 is perhaps the most striking example with hearing loss for speech of only 7 db and discrimination scores of 54 and 58 per cent The first two cases could not discriminate any speech in the affected ear — neither the relatively easy spondees nor simple questions and instructions The loss of sensitivity for pure tones in the speech range in these two cases is such that one would certainly predict sufficient discrimination for speech to permit at least the measurement of hearing loss for spondees Case 3 is additionally interesting in that a partial recruitment was observed and that the surgical findings here indicated the presence of pressure on the internal auditory artery as well as the VIIIth Nerve. This agrees with the report of Dix and Hood[6] regarding recruitment in a small percentage (8 per cent) of their series of central auditory lesions in which interference with the cochlear blood supply was observed

It is also interesting to note the presence of diplacusis in three of the cases This is worthy of further investigation since prevalent conceptions tend to associate diplacusis with cochlear lesions Eby and Williams,[2] for example, report diplacusis in 23 of 27 cases of end-organ deafness and in only one of 16 cases of nerve fibre deafness

It should be noted here that in our experience cochlear lesions, as in Meniere's disease, have uniformly exhibited recruitment. Additionally severe discrimination loss for speech is observed in cochlear lesions if the hearing loss for speech is greater than 20 db In this connection, however, the report of Hirsh, Palva and Goodman [7] that a low speech discrimination score is associated with recruitment if the hearing loss for speech is greater than 20 db, requires modification since the data reported here indicate that recruitment is not a necessary condition for a poor speech discrimination score associated with a mild loss of sensitivity While the presence of recruitment concomitant with a hearing loss for speech of greater than 20 db is usually associated with low speech discrimination, it now appears that such central auditory lesions as are represented in this study will likewise result in poor speech discrimination no matter what the hearing loss, and in the absence of recruitment

CONCLUSIONS

The conclusions of this report may be stated on a tentative basis subject to the obvious need for additional data *1* The relation between threshold loss and discrimination for speech does not differentiate between auditory lesions in the cochlea and those central to the cochlea At the very least these observations dictate considerable caution in interpreting very poor discrimination for speech associated with moderate threshold loss as being *unrelated* to central auditory lesions *2* Greatly diminished discrimination for speech with moderate sensitivity loss does not necessarily predict the presence of recruitment *3* Recruitment is characteristically absent in central lesions, and it apparently remains as the only auditory sign which differentiates between cochlear and retrocochlear lesions

We are indebted to Dr Henry G Schwartz, Professor of Neurosurgery, for making these cases available

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COMBINED DEFECTS OF THE COSMETIC PROFILE

Corrective Rhinoplasty with Simultaneous
Repair of Simple Retruded Chin.

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It is always necessary to consider the ultimate result with regard to the entire facial structure when attempting cosmetic rhinoplasty In cosmetic rhinoplasty it is usually not sufficient to obtain a "pretty ' nose A nasal contour which is perfectly adequate for one person may be totally inadequate for another individual of differing overall facial configuration This relationship is strikingly evidenced in what may be called the nose and chin profile[1,2,3]

It is just as important and oftentimes more so to alter the chin in direct proportion to the nasal correction The problem, therefore, of attempting to give the patient "a nose to fit the face" becomes twofold and can more accurately be stated as "a nose and chin to fit the face "

There are usually two types of chins with which we are concerned, the receding (micrognathic) and the protruding (prognathic) jaw Either one of these may or may not be associated with malocclusion If malocclusion is present, and the patient is treated before puberty, satisfactory results can be obtained by proper orthodontic procedures in a good many cases. If, however, the patient is seen in adult life, and an appreciable degree of malocclusion is present, osteotomies, either through the ramus or through the body of the mandible become essential This requires interdental wiring which should remain in position approximately six to eight weeks for proper immobilization

In cases of severe retrusion, where even osteotomy is not sufficient, an intra oral prosthetic appliance which fits into a previously prepared epithelium lined pocket is recommended[4]

The protruding jaw can be corrected either by ostectomy or osteotomy In ostectomy, a portion of bone is removed from

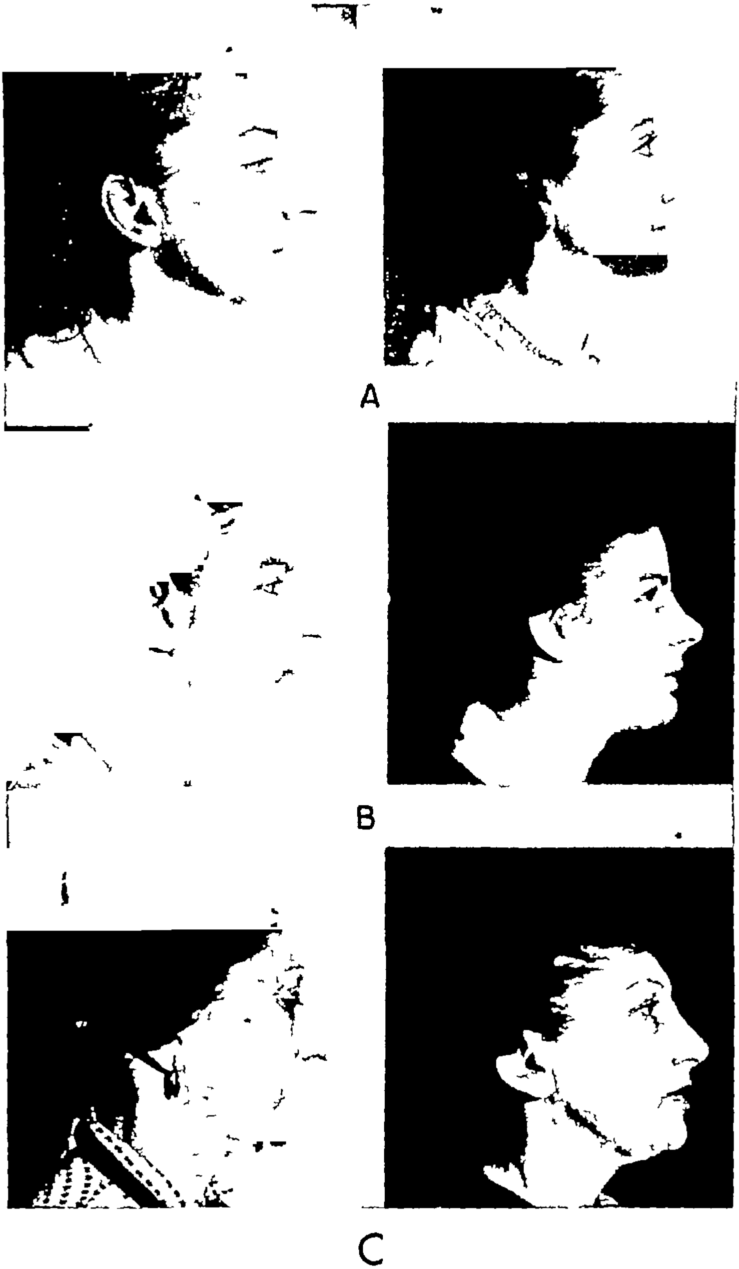

Fig 1 A, B and C Rhinoplasty and chin build-up with preserved costal cartilage implant.

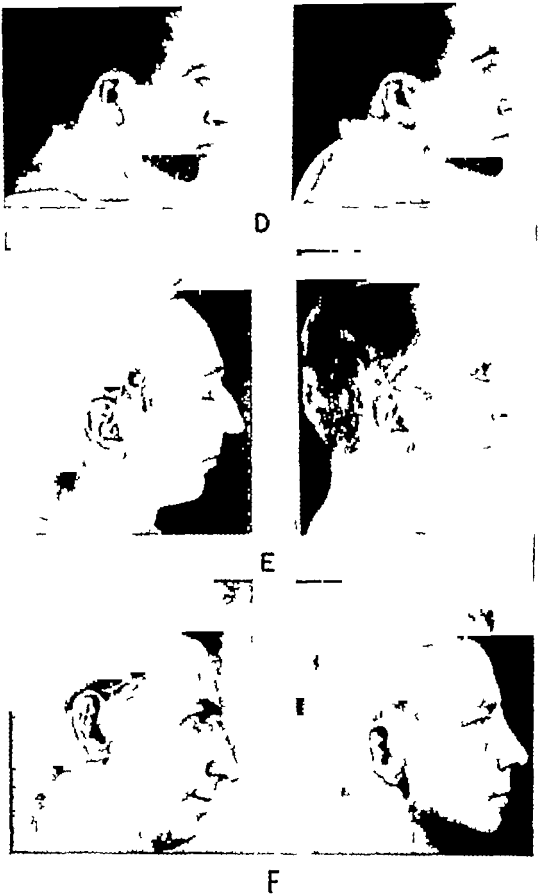

Fig 3 D Rhinoplasty and chin build up with preserved costal cartilage implant.

E and F Rhinoplasty and chin build up utilizing the patient's own nasal "hump" the body, the angle or the mandibular condyle. Osteotomy is usually done through the ascending ramus of the mandible. These procedures, again, require interdental wiring and appliances.

Most of the cases seen in adult life show either a minor degree or no evidence of malocclusion, and a retruded chin. These cases, fortunately, require the simplest form of reconstruction. The results, however, are rather dramatic, as can be seen in the accompanying illustrations. Completely satisfactory results cannot be achieved when the surgical procedure is limited solely to rhinoplasty.

Correction in most of these cases can be accomplished by the use of various substances to build out the contour of the chin. Several substances have been advocated over the years. Among these, we find substances totally foreign to the human body, such as ivory, polyethylene[5,6] and methyl methacrilate.[7] These substances have the disadvantage of behaving like a foreign body and favor reaction in the tissues. Frequently, slight trauma may produce infection and cause extrusion.

Of the substances not totally foreign to the human body, we have fresh rib cartilage from the patient himself or a compatible blood relative. Autogenous cancellous iliac bone has been used with marked success.[8,9,10] Use of bone by the intra-oral route has been reported.[11] Fat-dermal grafts have also found their advocates.[12,13] This group, of course, requires the inconvenience of subjecting the patient to a separate procedure and this is usually undesirable. Most patients will consider the reconstruction of the chin and nose, but will not welcome the additional surgical procedure for the removal of costal cartilage or iliac bone. The use of bovine cartilage[14,15] has been used with apparently marked success. The cartilage is prepared commercially by the Armour Laboratories of Chicago, Illinois. It is imperative that this type of cartilage not be diced, as complete absorption is sure to follow. Autogenous rib cartilage has the tendency to curl, therefore, it has been advised that the cartilage either be diced or subjected to a double-boiler bath for at least 15 minutes.[16] This boiling will, of course, destroy the viability of the cartilage. It will, therefore, give us a cartilage which is not better than preserved material

Preserved cartilage is easily obtained and stored It is usually obtained from adults, preferably in their second or third decade, who have died from causes other than tuberculosis, neoplastic or infectious disease

The costal cartilage is removed under sterile conditions, the sections freed of perichondrium and refrigerated in individual bottles of 1 1000 aqueous solution of merthiolate In three weeks, under sterile precautions, the cartilage is transferred to new bottles containing aqueous merthiolate solution in the strength of 1 3000 Each specimen is cultured at this time and again should be cultured prior to its utilization

Figures E and F represent the use of nasal hump alone in reconstruction of the chin The nasal hump is frequently used[17] either alone or with the addition of either preserved or autogenous septal cartilage This usually does not have the bulk desired and is fairly difficult to trim properly Costal cartilage, because of its bulk, availability and ease of handling, is the material of choice (See Figures A - D)

Correction in most of these cases is accomplished at the same time The rhinoplasty is done first by the individually desired method and the chin reconstruction follows

Technique consists essentially of the following

The areas are prepared and draped in the usual manner The chin is then anesthetized with 1 per cent procaine solution containing 12 drops of adrenalin, 1 1000 to the ounce. Anesthesia should start in the midline and be carried laterally on the bone to include the mental nerves as they exit from the mental foramina

With a No 15 B-P blade, an incision measuring 2-3 cm is made at the first chin line zone until contact with bone is made With a small periosteal elevator, the periosteum is lifted from the bone and a pocket of the desired size is made It is very important that the subperiosteal dissection not be carried too far cephalad for fear of perforating the gingivolabial mucosa The pocket should not be made any larger than

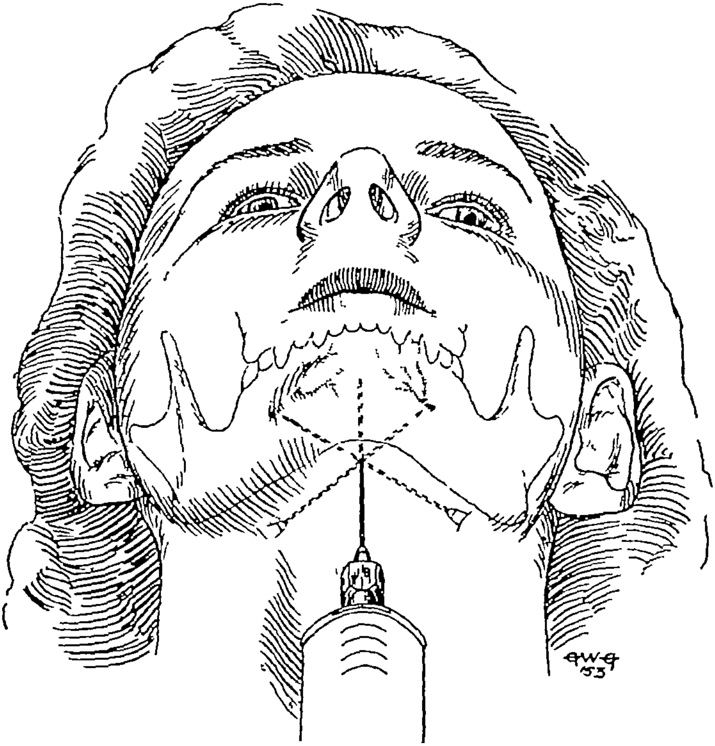

Fig 3 Anesthesia accomplished by infiltrating in the midline and extending laterally to include the mental nerves as they exit from the mental foramina.

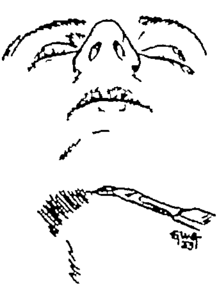

Fig 4

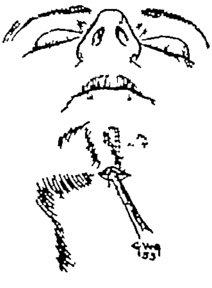

Fig 5

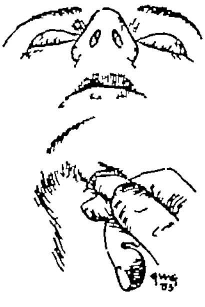

Fig 6

Fig 4 Incision made with a No 15 blade under the chin and carried down through periosteum

Fig 5 Elevating of periosteum with an elevator to create pocket for graft

Fig 6 Insertion of cartilage graft into pocket.

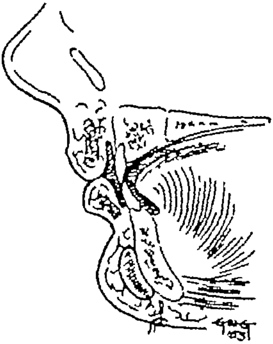

Fig 7 Graft in situ anterior to the lower portion of the mandible

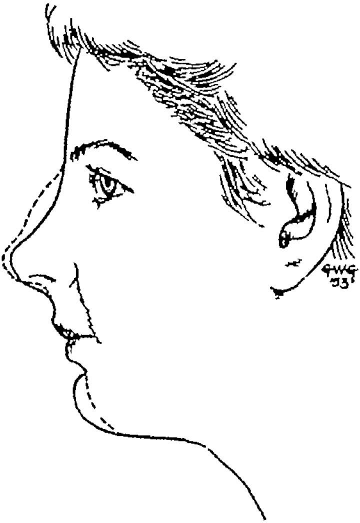

Fig 8 The pre and post operative contours of Case B

the graft If it is made larger, the graft will have a tendency to be displaced The graft is then inserted into the pocket and is left in contact with the bone It is important to control all bleeding One or two No 000 chromic catgut sutures for approximation of periosteum and fine black silk sutures for the skin are used in closing A pressure bandage using elastoplast (elastic adhesive) is used and left without changing approximately six days At the end of this time, both the nasal "mask" and the chin dressing are removed, the sutures being removed also at this time No further dressing need be applied

This procedure offers no appreciable discomfort to the patient and is done concomitantly with the rhinoplasty, therefore, it does not prolong hospitalization and offers some of the most gratifying results both to the patient and the physician

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860 Fifth Avenue

THE AMERICAN OTORHINOLOGIC SOCIETY FOR PLASTIC SURGERY Inc.

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KENFIELD SCHOLARSHIP

The American Hearing Society announces March 1 as opening date for competition for the 1955 Kenfield Memorial Scholarship, an award made annually to a prospective teacher of lipreading Application blanks may be obtained by writing to the society's national headquarters, 817 14th St , N W , Washington 5, D C

Deadline for returning completed applications is May 1 They are to be mailed to Mrs Dorothy J Cornett, 4310 S W 14th St., Coral Gables 34, Fla

Winner of the Kenfield Memorial award is entitled to take a teacher training course in lipreading from any school or university in the United States acceptable to the Teachers Committee The scholarship is to be used within one year from the date of award

ARTERIOVENOUS ANEURYSM OF THE INTERNAL CAROTID ARTERY AND CAVERNOUS SINUS, TREATED BY LIGATION OF EXTERNAL AND INTERNAL CAROTID ARTERIES *

JACKSON A SEWARD, M D ,
New York, N Y

William Hunter in 1761, defined arteriovenous aneurysm as "The rupture simultaneously of an artery and a vein in which the blood flows directly into a neighboring vein or else is carried into such a vein by a connecting sac "

Arteriovenous aneurysm of the cavernous sinus and the internal carotid artery is a rare condition, however, many cases have been reported In 1809 Travers described the first case of pulsating exophthalmos In 1907 De Schweinitz and Holloway reported 69 cases In 54 of these cases the exophthalmos was due to trauma, in 13 it was spontaneous, and in one it was the result of a tumor, the other cause was not given The average age of the patients with exophthalmos due to trauma was 30 years, and the average age of the patients with spontaneous exophthalmos was 42 years

In nine cases the hearing was impaired or lost, in one case the smell was markedly impaired, in one, the taste was impaired, and in five cases the ophthalmic branch of the Vth Cranial Nerve was involved Pulsation was present in nearly all cases, but bruit could be heard in only nine

The bruit can usually be controlled by pressure over the common carotid artery of the affected side The continuity of the bruit indicates an arteriovenous aneurysm, and an interrupted bruit indicates a true aneurysm

TREATMENT

Reuchlin treated 68 cases with digital compression over the common carotid on the affected side and reported 15 cures and 53 failures

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* Read at the Staff Conference of the Manhattan Eye Ear and Throat Hospital New York City Nov 4 1954

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Dorrance and Loudenslager claimed ligation of the common carotid was the most satisfactory treatment They reported that of 69 cases in which the internal carotid was ligated, hemiplagia occurred 13 times, permanent in four cases, in three, recovery was slow, and in the remaining six cases, hemiplagia was only temporary

In a series of 82 cases, in which the common carotid artery was ligated hemiplagia occurred in six cases It was not permanent in any and was more than transient in only one case

Various materials have been used for ligatures such as alloy steel wire, aluminum band, fascia lata, chromic catgut and silk

CASE REPORT

This is the report of a white male 52 years of age who walked into the admitting office of Bellevue Hospital New York City on the evening of July 17 1944.

His chief complaint was of a swollen left eye which began to swell three days before and felt as though it would 'pop out." Severe pain preceded the swelling and spread to the forehead. The pain gradually subsided but the swelling of the eye persisted There was impairment of vision in the left eye and there was a buzzing in his left ear both of which followed a blow on his jaw six or seven weeks previously

On physical examination an exophthalmos of the left eye, with marked chemosis of the lower half of the conjunctiva and paralysis of the left external rectus muscle was found Vision in the left eye was impaired and the left pupil did not react to light and accommodation A bruit could be heard over the left eye and the left temporal region and left mastoid and could be controlled by compressing the common carotid artery His ears were normal there was no infection in the nasal sinuses and the blood pressure was 150/100 The blood count was normal and the Wassermann negative.

It was decided that ligation of the left common carotid artery offered the best chance of relief, and on July 25 this procedure was started under local anesthesia but during the operation it was decided that the same results could be accomplished by ligating the external and internal carotids separately Local anesthesia was selected because it would enable us to determine the effect of the occlusion of large arteries but the patient was so agitated and confused from the morphine and hyocine which he received before being sent up to the operating room, that co-operation was not only lacking but also antagonism was encountered Hence the operation was interrupted while a general anesthetic was instituted The common carotid was exposed and the bifurcation identified. One large black silk thread was placed around the internal carotid artery and another around the external carotid artery By traction the flow of blood was stopped separately through each then stopped through both simultaneously while the blood pressure respiration and pulse were watched carefully There being no marked change in either these arteries were ligated separately with black silk.

No untoward signs were noted postoperatively and the left exophthalmos had receded 3½ mm the next day Buzzing in the left ear and the bruit had disappeared also by the next day After one week the left external rectus muscle was functioning normally The exophthalmos continued to recede slowly but had not entirely reached its normal position when the patient was discharged from the hospital, August 14, 1944

SUMMARY

A case was reported which presented the cardinal symptoms of arteriovenous aneurysm of the internal carotid artery and cavernous sinus, following trauma, namely, exophthalmos with pulsation and bruit which could be heard in the temporal region over the mastoid, and could be controlled by compression of the common carotid artery on the affected side

Relief was accomplished by ligation of the internal and external carotid arteries First day postoperatively, the exophthalmos had receded 3½ mm, and both bruit and tinnitus had disappeared

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The Department of Otolaryngology, Indiana University School of Medicine, offers its annual Anatomical and Clinical Course in Otolaryngology, February 7 - 19, 1955 Applicants should address The Post-Graduate Office, Indiana University Medical Center, Indianapolis 7, Indiana

THE CONTROL OF POSTOPERATIVE ADENOID BLEEDING WITH ADRENOSEM *

CAPERS B OWINGS, M.D ,

Germantown, Penna

For the past six or seven years at Germantown Hospital we have had much more postoperative adenoid bleeding than we had years ago In an attempt to check this trend we have *1* Used varied techniques and have attempted to remove all vestige of adenoid tissue under direct vision, *2* Given ascorbic acid and vitamin "K", *3* Been very conservative about operating if there was any history or evidence of recent upper respiratory infection *4* Tried various preoperative medication

In spite of these procedures, we have continued to have much too frequent adenoid ooze requiring postoperative manipulation, or the application of post nasal packs and sometimes blood replacement by transfusion Bleeding from the tonsil fossa has not been more than average and has usually been controlled by suture on the table with an occasional secondary suture being necessary

We have no knowledge as to why this adenoid bleeding has increased during the past few years Some possible causes could be changes in the type or action of the various virus infections and the possible change in tissue response from the use of the various antibiotics Other undetermined causes certainly must play a part

During the Spring of 1954 Adrenosem (Massengill Co) was called to my attention and since that time has become a routine preoperative medication We have used 2½ mg (½ ampule) intramuscularly, 15 minutes before anesthesia for children and 5 mg (1 ampule) for adults We have not done a scientific study with controls and we have only 102 cases upon which this medication has been used Before its use we had

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*Read at the Meeting of the Philadelphia Laryngological Society Nov 1954

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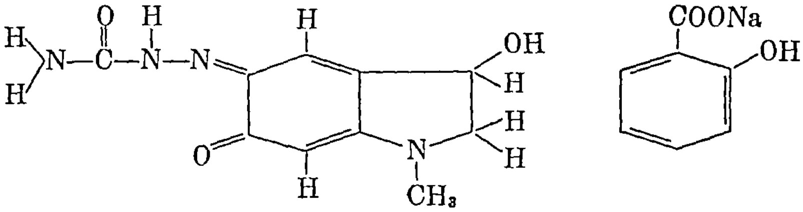
adenoid bleeding in approximately 10 per cent of all cases Since its routine use we have had only one in 102 cases with three others who showed some bright red blood from the nose and mouth, who were then given 5 mg (1 ampule) intramuscularly with prompt and complete control We have also noticed that bleeding stopped more promptly on the operating table

The 102 cases described do not include allergic individuals upon whom I have deferred T & A during the pollen season because of the possibility of increasing their allergic sensitivity After frost, when this group will be operated upon, we will undobutedly show whether or not nasopharyngeal bleeding in this group can be controlled with this drug

Adrenochrome has been known by research workers for a number of years to be a systemic hemostat, but it has been a laboratory curiosity because of its stability being limited to not more than four hours Green and Richter described the monoxime and mentioned the semicarbazone Both are stable but quite insoluble When complexed with sodium salicylate, however, they are both stable and soluble The amount of salicylic acid radical in this combination is so small that it can be ignored as a cause of bleeding

Adrenosem is a synthetic chemical with the following formula



Molecular weight 396 337

The manufacturers of this preparation claim that it has no sympathomimetic action, will not significantly raise blood pressure or affect the cardiac rate or volume It has no effect on blood chemistry and does not interfere with the blood clotting mechanism or its compounds The administration of vitamin "K" concomitantly will not interfere with its reaction nor it with vitamin "K" It can be administered with heparin and anticoagulants

When administered orally or intramuscularly (not to be used intravenously because it is hypertonic) it is absorbed rapidly, there are no cumulative effects, it is rapidly oxidized and eliminated completely in 12 hours It is excreted 50 to 70 per cent through the kidneys with 25 to 30 per cent being excreted as extra indol which is thought to have been converted by bacterial action

The manufacturers claim that Adrenosem appears to be specific for conditions characterized by increased capillary permeability It checks bleeding from a capillary bed by causing correction of excessive permeability and increase in capillary resistance This drug has no effect on large, severed arterioles or blood vessels The use of antihistamine drugs during the previous 36 hours may retard its action

It is not known exactly how Adrenosem works, but it is theoretically considered that the connective material between cells loses its elastic tone and that Adrenosem increases this tone. This is partly demonstrated by work on the cheek pouch of a hamster, in the Department of Biology of Boston, by Dr Fulton In the control animal mucous membrane was irritated with snake venom causing small hemorrhages and extreme capillary permeability A 500 times magnification shows red cells escaping to surrounding tissue Another animal was treated with Adrenosem and in 30 minutes the same amount of snake venom was used as an irritant. Microscopic examination showed intact capillary walls and blood cells coursing through the capillaries with only scant escape of erythrocytes

Adrenosem has shown no cumulative effect on human subjects treated for over two years and no toxic effects attributable to the drug There is a high index of therapeutic safety at the usual dosage levels and there seem to be contraindications It has been determined that the lethal dose$_{50}$ in experimental animals is 30 5 mg per kilo of body weight.

We have used this drug only for control of postoperative adenoid ooze and in one case of familial telangiectasis and we believe, with excellent results The manufacturers suggest that it has been of value in Idiopathic Purpura, Retinal Hemorrhage, Familial Telangiectasis, Epistaxis, Hemoptysis, Hematuria, Pulmonary Bleeding, Bleeding after X-ray Therapy, and in any surgical situation in which capillary bed bleeding might occur This drug has not been shown to be of value in blood dyscrasias or in diseases or conditions where there is interference with the blood clotting mechanism

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The next Bronchoesophagology Course to be given by the Temple University School of Medicine is scheduled for January 31st - February 11th, 1955, under the direction of Dr Chevalier L Jackson

Interested registrants will please write directly to the Department of Laryngology and Bronchoesophagology, Temple University School of Medicine, 3400 North Broad Street, Philadelphia 40, Pa

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The Georgia Society of Ophthalmology and Otolaryngology will meet March 11 - 12, 1955, at the General Oglethorpe Hotel, Savannah, Georgia

The speakers will be Dr Francis H Adler, Philadelphia, J W McCall, Cleveland, Dr J A Hilger, St Paul, Dr Walter H Fink, Minneapolis, Dr James H Allen, New Orleans, and Dr P E Ireland, Toronto, Canada For further details, address Alton V Hallum, M D, Secretary, 245 Doctors Bldg, Atlanta 3, Ga

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SYMPOSIUM

INTRACRANIAL COMPLICATIONS OF OTITIS MEDIA AND MASTOIDITIS IN THE ANTIBIOTIC ERA

I Modification of the Pathology of Otitic Intracranial Lesions by Antibiotic Preparations *†

CYRIL B COURVILLE, M D , (by invitation),

Los Angeles, Calif

Among the many great triumphs of medicine which have contributed to the conquest of disease, the use of antibiotic substances stands out pre-eminently In no field of medicine has this achievement become so evident as it has in the intracranial suppurative diseases. This type of medication has become so effective as to threaten the very existence of those serious and very often fatal intracranial complications of otitis media and accessory nasal sinusitis

The various lesions which constitute this group of infectious diseases, extradural and subdural abscess, venous sinus thrombosis, suppurative meningitis and abscess of the brain, were once commonly oberved at autopsy during the colder months of the year, even in the benign climate of Southern California, now they are very unusual and noteworthy

To the present generation of younger physicians, all this is

Read at the meeting of the Western Section, American Laryngological Rhinological and Otological Society Inc., Los Angeles, Calif., January 16 1955.

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accepted as a matter of fact Only those who were once obliged to stand helpless by the side of patients who were dying of one or more of these complications after a long hard fight, are able to appreciate the miracle which has transpired within the past two decades Even those of us who are in a position to compare the era so recently gone and the present one can profit by an analysis of the nature and extent of our triumph Of greater importance, however, is a critical survey of what remains to be done and to consider measures which seem to be necessary to complete the task

It is proposed, therefore, in this brief summary to make an up-to-date evaluation of the situation as it now exists with respect to the complications of otitis media and mastoiditis such as Dr J M Nielsen and the writer did some 21 years ago Attention will be drawn to the almost total elimination of thrombosis of the venous sinuses and of the dural infections, the stubborn persistence of meningitis and the reasons thereof, and finally the altered aspect of the problems of abscess of the brain as it appears today,* but before these details are investigated a comparison of the incidence of these complications over a five-year period before and after the introduction of antibiotic medications will be illuminating

COMPARATIVE AUTOPSY STATISTICS IN THE PREANTIBIOTIC AND ANTIBIOTIC ERAS

A study of the autopsy statistics of the incidence of otitic intracranial complications made in the period before the introduction of antibiotics disclosed some fundamental aspects of the problem (Courville and Nielsen, 1934) In an analysis of these lesions in fatal cases of otitic complications over a consecutive five-year period (July 1, 1928, to June 30, 1933), it was learned that approximately 25 of every 1,000 deaths in the Los Angeles County Hospital were due to some intracranial complication of otitis media (124 fatal cases in 5,227 autopsies in this period)

The incidence of these complications varied from year to year both in numbers and types of lesions Meningitis, of course, was always the most common complication, thrombosis of the dural sinuses the next most common, and abscess of the brain usually the least common, although in one year this lesion was more often encountered than thrombosis This fluctuation in the incidence of intracranial complications was not comparable, oddly enough, to the cases in which otitis media or mastoiditis was found at autopsy

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* Because this study is concerned primarily with our own experience in a single large hospital references used in this study will be limited largely to those emanating from the professional services of the Los Angeles County Hospital

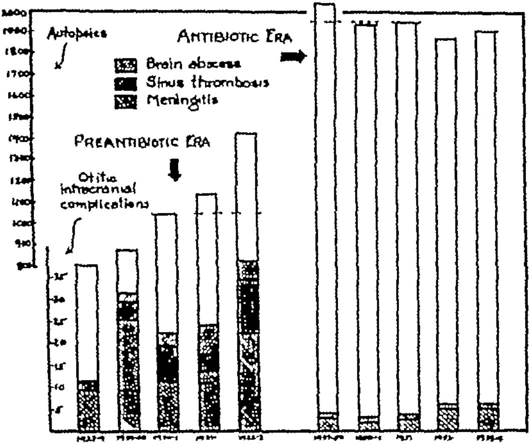

Fig 1. Chart giving comparative necropsy incidence of otitic intra cranial complications in preantibiotic (1928 1933) and antibiotic (1949 1954) eras.

To compare with these figures, the statistics of a second five-year period well within the antibiotic era were investigated (July 1, 1949, to June 30, 1954) In this period only 23 cases of fatal otitic intracranial complications were discovered in a series of 9,737 consecutive autopsies, approximately 25 in every 10,000 deaths in this hospital (see Fig 1) This is about one tenth of what it was 20 years ago In other words, the drop in death rate from these complications has been approximately 90 per cent.

It is found that meningitis is still the most common complication On the other hand, thrombosis of the dural sinuses has been practically eliminated An occasional case of adjacent abscess of the brain, chiefly of the temporal lobe, was encountered during this period

Only one example of "distant" otitic brain abscess, which, as has been pointed out, is secondary to an invasion of the lateral sinus and its communicating afferent veins, has been observed during this interval In this case, a fulminating abscess of the right frontal lobe was associated with a bilateral frontal subdural abscess, also frequently secondary to venous extension

The significance of this change will be discussed under the separate lesions, considered in more detail in subsequent paragraphs

THE DURAL INFECTIONS

In the old days the incidence of otitic dural lesions, both from a clinical and pathological viewpoint, was relatively high It was true, of course, that these lesions *per se* were of relatively small clinical concern, for they were in themselves rarely fatal and infrequently demanded surgical attention In most cases pachymeningitis externa and interna and their purulent counterparts, extra- and subdural abscess, represented only a stage in the process of direct layer-by-layer invasion of the intracranial space The accumulations of fibrin or pus were small and added little if anything attributable to the manifestations of the toxic-septic state, nor did they betray their presence by any localizing symptoms or signs

The presence of the rare, larger accumulation of pus within the subdural space (subdural abscess, empyema of the subdural space) after otitis media and mastoiditis was even then very difficult to establish because of the lack of well defined localizing phenomena, and because of the absence of outspoken signs of sepsis Now it has become even more difficult after antibiotic substances have been administered, because of the reversal of leukocytic response in the blood and spinal fluid and the absence of fever

The writer has seen but three such cases in the past decade. In one, a small child with chronic otitis media, inadequately and inappropriately treated with antibiotics, developed suggestive signs of a right cerebellar abscess At operation this abscess proved to be a small one and was apparently adequately drained The child failed to recover and remained quite ill, even though there was no rise of temperature and no leukocytosis After a slow downhill course to death, an extensive abscess was found to involve the entire subdural space of the right posterior fossa with extension into the left and above the tentorium below the right occipital lobe

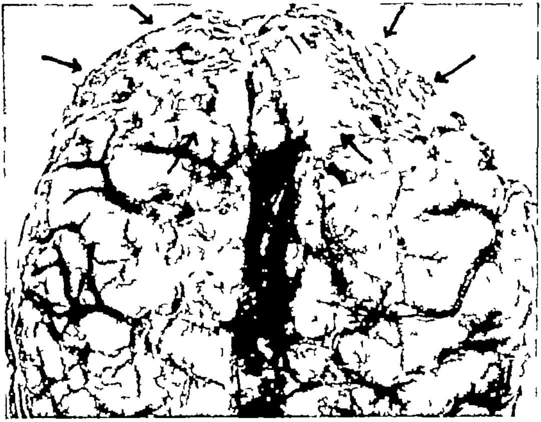

Fig 1 Otitic subdural abscess (Aut. No 45 911) The spread of exudate over both frontal lobes, as well as localization of a distant diffuse abscess within the right frontal lobe suggests retrograde extension of infection by way of the venous system. See also Fig 6 showing nature of underlying cerebral abscess.

In the two other cases, both adults, which came to light in the present survey of fatal intracranial complications, the subdural abscess was associated with acute fulminating abscesses of the brain substance In one the causative otitis infection (left ear) was of life-long standing Death came after an acute exacerbation, and at autopsy a subdural abscess was found in the left middle fossa and found to be associated with an acute abscess within the left temporal lobe

In the second case, an exacerbation of a chronic right otitis media was followed by an acute fulminating abscess without effort at encapsulation of the right frontal lobe A subdural abscess of considerable extent was found over both frontal lobes (see Fig 2) The intracerebral lesion must have been due to venous spread, as indicated by its "distant" location, and the associated subdural abscess may well have been a coincident rather than a consecutive lesion from the same invasion

In the light of the writer's experience with postmortem lesions of this type, they are bound to be of extremely rare occurrence and then usually associated with, and probably secondary to, abscesses within the brain substance Their clinical diagnosis will be even more difficult, if not actually impossible The lesson to be learned is that the clinician must continue to search for possible complications of this and other types so long as the patient does not fully recover

VENOUS SINUS THROMBOSIS

As in the case of other dural infections, thrombophlebitis of the dural venous sinuses and their afferent veins has been almost totally eradicated from the list of otitic infections of the intracranial space This is due in no small degree to the prevention of acute mastoiditis, which was the most common cause of thrombosis of the lateral sinuses and their afferent vessels

In the period of five years, from 1949 to 1954, not one example of thrombosis of the dural sinuses was found at autopsy In one case of a young infant, thrombosis of the internal venous system of Galen associated with an otitis media was the obvious cause of death (see Fig 3) The otitic infection may have been a contributing factor in what we have come to call the "mixed" (infectious and autochthonous) type of sinus thrombosis It seems quite clear that the use of antibiotics in acute otitis, which has prevented the extension of the infection into the mastoid, has thereby prevented the development of the consecutive involvement of the lateral (and less often the petrosal) sinuses.

In backward areas where medical attention is not immediately available, or ignorance and neglect prevents prompt antibiotic therapy, the infective type of dural sinus thrombosis may still be occasionally seen. In most communities, however, it is a lesion only with a past.

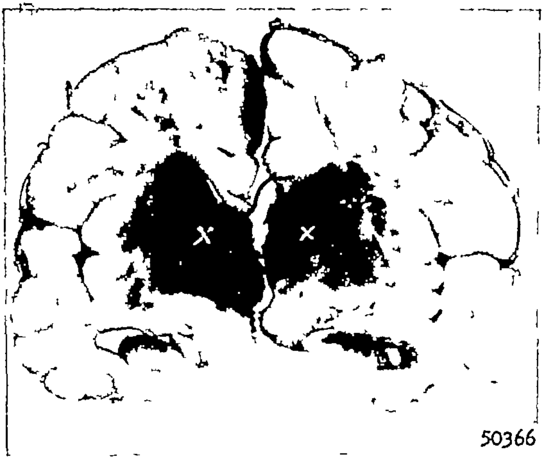

Fig 3 Red softening of basal ganglia and surrounding cerebral centrum in an infant with otitis media (Aut. No 50 366) This is a pre*sumed case of a "combined type of venous thrombosis of the internal* venous system in which an infection (otitis media) and dehydration combine to result in thrombosis of the venous system

There still remains however, the possibility of the "combined type" of thrombosis In this situation both otitis media and dehydration combine their malign influences to provoke an occlusion of the lateral and/or superior longitudinal sinuses, less often also the internal cerebral system of veins This situation might readily develop in feeble infants who infection (left ear) was of life-long standing Death came after an acute exacerbation, and at autopsy a subdural abscess was found in the left middle fossa and found to be associated with an acute abscess within the left temporal lobe

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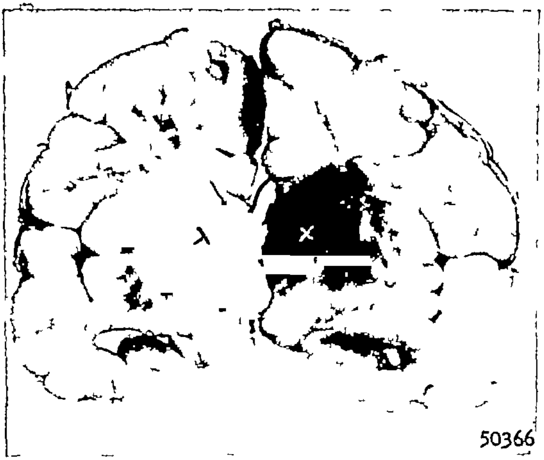

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THE PERSISTENCE OF MENINGITIS

The most dreaded of all intracranial complications of otitis media, septic or suppurative meningitis, continues to maintain its identity in spite of the various antibiotic agents More than this, it has continued to claim its victims even from among those in whom these lesions seemed at first to be ameliorated by medication It, therefore, behooves us to give more attention to this lesion during this recent period

In the antibiotic era, the suppurative form of meningitis now constitutes by far the most common intracranial complication of otitis media It was the cause of death in 18 of the 23 fatal cases studied at autopsy (78 per cent) This percentage is to be compared with that of the previous era, when meningitis occurred in 68 per cent of the fatal otitic intracranial complications (85 times in 124 cases) It is of interest to note that in two of the 18 cases, the meningococcus was the infecting organism, an interesting situation which also existed in the era before antibiotics were introduced

What are the underlying factors which permit meningitis to survive as the most lethal complication of infections of the ear? First of all must be considered the very nature of the lesion, with the diffusion of the exudate through the subarachnoid space permitting not only its noxious effect on the functions of the brain as a whole, but also permitting the widespread absorption of the exo- and endotoxins of the invading organisms

By the same token, the difficulty for any antibiotic agent to reach these organisms through the accumulation of heavy exudate in the subarachnoid space would also contribute to the failure of therapy in some cases This is clearly seen in the process of recovery of meningitis after antibiotic therapy

Recovery from Meningitis A study of a series of partially healed cases of postotitic suppurative meningitis discloses some interesting facts The action of antibiotic substances seems to emanate from the blood vessels in the subarachnoid space and the pia mater The first evidence of this action appears as exudate free areas and zones about these vessels This is followed by a progressive widening of these zones until the exudate is broken up into isolated patches (see Fig 4)

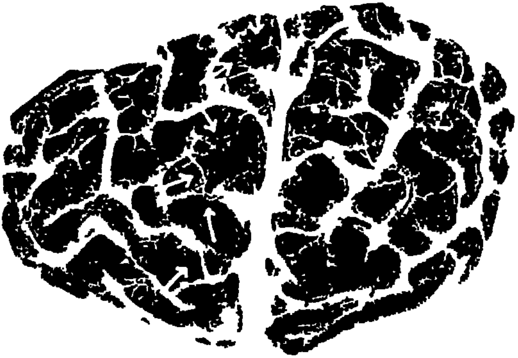

Fig 4 Healing otitic meningitis (Aut. No 39 017) Tips of the frontal lobes showing residual patches of exudate (arrows) after strenuous antibiotic therapy

These patches are not only progressively reduced in size but also become less dense as time goes on Finally only faint regional clouding remains to show that an inflammatory reaction in the subdural space was once present. Then the meninges resume their normal appearance in most cases without residual adhesion formation Microscopic study reveals at this stage only scattered leukocytes chiefly in the form of lymphocytes and large mononuclears

In addition to these cases in which antibiotic therapy is imperfectly effective and in which death occurs in spite of even advanced degrees of dissolution of exudate, there still remains a group in which such treatment is unavailing, due to the immunity of the infecting organism In such cases in which death occurs after an acute course a thin exudate is found at autopsy, often with associated focal subarachnoid hemorrhages (see Fig 5)

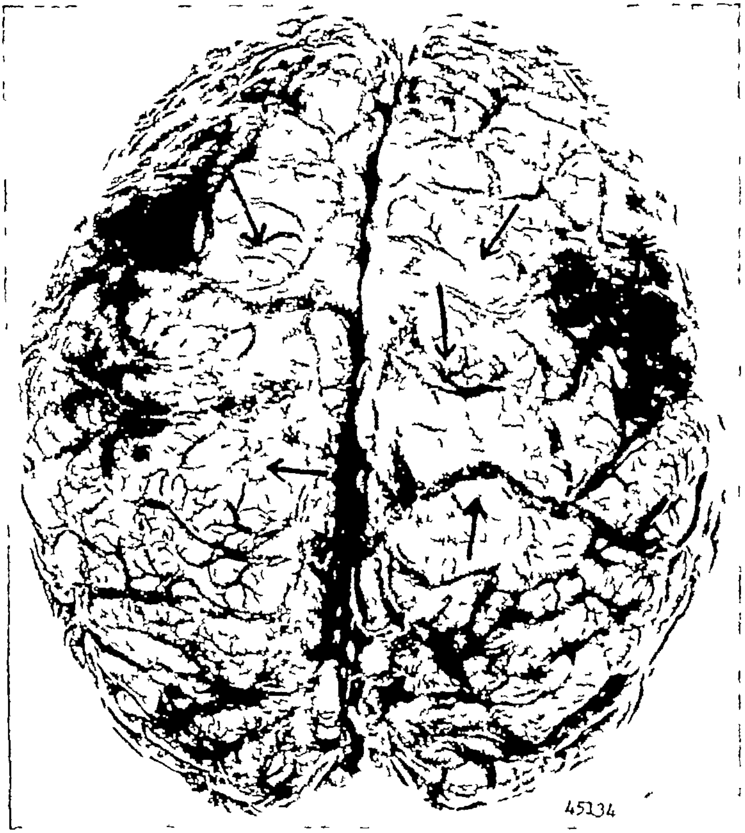

Fig 5 Acute otitic meningitis in which infection did not yield to antibiotic therapy (Aut. No 45-134) Milky clouding of the leptomeninges is associated with focal subarachnoid hemorrhage (acute stage of meningitis)

Mixed infections in which one or more of the invading bacteria are resistant to the antibiotic used, appear to be a factor in some cases In still other instances, death is probably to be attributed to the low degree of resistance of the patient because of toxemia, dehydration or malnutrition. The bacterial toxic factor probably accounts for the patient's demise in case of those individuals who die in spite of subtotal or even total disappearance of the exudate The vital centers have not been able to hold out against those toxins long enough for recovery to occur

THE ALTERED ASPECT OF OTITIC ABSCESS OF THE BRAIN

The complex picture presented by the various avenues of invasion and pathological aspects of otitic abscess of the brain has been fairly well worked out during the preantibiotic era This was particularly true of the less well understood group of "distant" lesions in which invasion of the nervous tissues seemed to take place by way of the dural sinuses and their afferent veins *The total number of postotitic lesions in the* form of actual abscess has, of course, been markedly reduced by antibiotics, as in the case of other lesions This is clearly evident in the statistics available in the autopsy records of this hospital

In the recent five-year period only four cases of otitic abscess of the brain were encountered in 9 737 consecutive autopsies One of these (No 42-537) was an acute temporal abscess with some local subdural exudate, the second (No 43-428) was also an acute abscess, the third (No 45-911) was an acute diffuse abscess of the frontal lobe with an associated subdural abscess, probably resulting from a mixed infection with aerobic organisms, while the fourth (No 47-923) was an abscess still in the stage of a local "encephalitis" in the adjacent temporal lobes It is noteworthy that all these lesions were acute and fulminating

In this present era the total picture of otitic abscess of the brain has been considerably modified by the use of antibiotic measures The usual type of "adjacent" abscess of the temporal lobe and cerebellum is still occasionally encountered, due to the resistance of bacteria in case of certain instances of chronic otitis, especially when complicated by cholesteatoma formation, but the ' distant" abscesses usually resulting from invasion of the intracranial venous system by way of the regional veins and the lateral sinus after acute otitis media in early life seem to have been fairly definitely and completely eliminated

Only one such case of this type has come to the writer's attention since antibiotics have been used—a diffuse abscess of the right frontal lobe (see Fig 6) There remains the possibility of several variants of abscess formation to be considered, *1* The abortive lesion in the brain without actual abscess formation, *2* Cases in which the abscess had largely formed before effective antibiotic treatment was given, and *3* Lesions in which antibiotic therapy was totally ineffective, especially in the case of certain mixed infections These various possibilities will now be briefly considered

Abortive Focal Infections of the Brain One must recognize that the old truism about otitic abscesses of the brain has not been altered by the introduction of antibiotics, that a recurrence of a chronic otitis media, less often an acute otitis media, may be followed at once by an invasion (via regional blood vessels) of the adjacent temporal lobe or cerebellum In this case the use of antibiotics may be followed by cure of the causative otitis media and by an interference with the complete evolution of the typical otitic abscess of the brain

The present writer has observed one case of a boy so treated who developed convulsive seizures several years after the otitic episode Roentgenograms of the skull showed a focus of calcification in the temporal lobe just above the middle ear It was assumed that antibiotic measures aborted the focal brain infection but that a residual calcified scar was ultimately responsible for the convulsive seizures

Effect of Antibiotics on An Existing Abscess There also remains the possibility that antibiotic therapy may be started after the abscess in the brain has already been formed In such instances the spread of infection to the adjacent brain tissue ("secondary encephalitis") to the meninges or the ventricles may be halted, and the abscess remains as a more or less quiescent lesion One such case was recently studied in the Cajal Laboratory It proved to be a small, well encapsulated and sharply delineated abscess of the temporal lobe Of particular interest was the contents of the abscess, which was

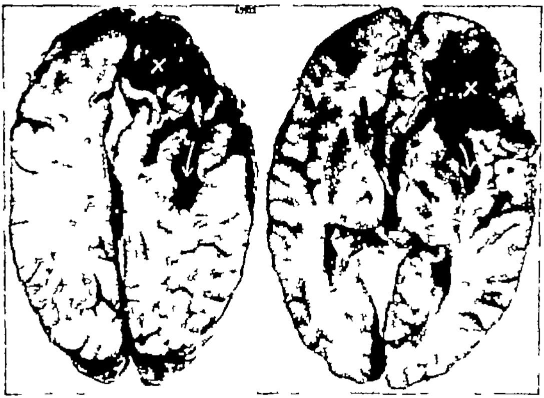

Fig 6 Acute diffuse distant otitic abscess of the frontal lobe (Aut. No 45 911) The location of this lesion and the presence of a bilateral frontal subdural abscess (see Fig) suggests retrograde extension along venous channels from the middle ear on the right side The nature of the lesion also suggests an infection with both aerobic and anaerobic organisms.

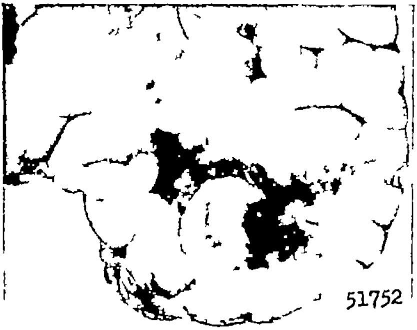

Fig 7 Diffuse adjacent" otitic abscess of the temporal lobe (Aut. No 51 752) The dependent white matter of the lobe has been eroded leaving the cortical ribbon unaffected. There was only a minimal reaction to the infection found on microscopic examination

clear liquid with a yellowish gray flocculent precipitate, the remains of the purulent exudate

Diffuse Abscess of the Brain Certain German students of intracranial complications of otitis media once pointed out the occasional occurrence of acute "diffuse" widespread infections in the brain in which there was no apparent attempt on the part of the nervous tissue (white matter) to wall off the original focus

These investigators suggested that such lesions were usually the result of invasion of the brain by multiple organisms The rapid spread of infection in the cerebral white matter was due to the presence of aerobic organisms which would multiply rapidly in the absence of oxygen Two such cases have recently come under study in the Cajal Laboratory In one the lesion occurred in the frontal centrum (see Fig 6), the other in the temporal lobe (see Fig 7) In both instances the brain was rather widely invaded, the central white matter being destroyed to form an irregular cavity without any gross evidence of encapsulation

It thus appears that although otitic abscesses of the brain still persist in spite of antibiotic therapy, their visage has been changed Our concepts of this lesion must likewise be adapted to these changes unless we be misled in the diagnosis of these lesions

SUMMARY AND CONCLUSIONS

From a survey of recent autopsy material from cases of otitic intracranial complications, it becomes evident that while such complications have been materially reduced in incidence as much as 90 per cent, they still occur in a somewhat variable form The greatest single accomplishment in this regard of antibiotic therapy has been the practically total elimination of dural sinus thrombosis This is due, of course, to the prevention of mastoiditis as a complication of acute otitis media

A study of this recent series of verified fatal complications brings to light certain important factors causative in the production of the fatal issue In 13 of the 23 cases reviewed,

death was the result of suppurative meningitis consequent to a fulminating acute otitis media often in a dehydrated and malnourished infant. Since this is the essential situation in over half of these cases (56 5 per cent), the problem of prevention now lies in the hands of the general practitioner and the pediatrician, however, this same situation was observed in two cases in adults with an acute *clinically undetected* otitis media following an upper respiratory infection

In five other adult cases, fatal meningitis followed acute or subacute otitic infection associated with earache and/or otorrhea. In two adults, fatal intracranial lesions (both with cerebral abscesses with associated subdural abscesses) were the direct result of a chronic draining ear with sudden development of febrile state From this it may still be said that a patient with a chronic otitis sits on a powder keg as far as potential intracranial complications are concerned

Meningitis has now become the chief hazard of infections of the ear as compared to other complications, although its actual incidence has also been remarkably reduced It now occurs most commonly as a fulminating development in poorly nourished infants with an otitis due to an organism resistant to the action of antibiotics essentially a pediatric problem Death may result, even though the gross evidence of meningitis has largely or even completely disappeared Infection with the meningococcus by way of the ear may also occur now as before

Otitic abscess of the brain still occasionally causes death of patients Such lesions are now almost invariably 'adjacent" lesions of the temporal lobe rather than the cerebellum In this group of cases treatment with antibiotics was begun too late, or the infection was due to the presence of a resistant organism If this organism chances to be an anaerobic variety, the brain may be rapidly and diffusely invaded ('diffuse brain abscess") It has also become evident that after antibiotic therapy certain pathological aspects of otitic abscess have become apparent which were rather uncommon before This altered picture of otitic abscess of the brain must be recognized, if the clinician is to keep pace with the changing situation

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From a survey of recent autopsy material from cases of otitic intracranial complications, it becomes evident that while such complications have been materially reduced in incidence as much as 90 per cent, they still occur in a somewhat variable form The greatest single accomplishment in this regard of antibiotic therapy has been the practically total elimination of dural sinus thrombosis This is due, of course, to the prevention of mastoiditis as a complication of acute otitis media

A study of this recent series of verified fatal complications brings to light certain important factors causative in the production of the fatal issue In 13 of the 23 cases reviewed,

death was the result of suppurative meningitis consequent to a fulminating acute otitis media often in a dehydrated and malnourished infant. Since this is the essential situation in over half of these cases (56 5 per cent), the problem of prevention now lies in the hands of the general practitioner and the pediatrician, however, this same situation was observed in two cases in adults with an acute *clinically undetected* otitis media following an upper respiratory infection

In five other adult cases, fatal meningitis followed acute or subacute otitic infection associated with earache and/or otorrhea. In two adults, fatal intracranial lesions (both with cerebral abscesses with associated subdural abscesses) were the direct result of a chronic draining ear with sudden development of febrile state From this it may still be said that a patient with a chronic otitis sits on a powder keg as far as potential intracranial complications are concerned

Meningitis has now become the chief hazard of infections of the ear as compared to other complications, although its actual incidence has also been remarkably reduced It now occurs most commonly as a fulminating development in poorly nourished infants with an otitis due to an organism resistant to the action of antibiotics essentially a pediatric problem Death may result, even though the gross evidence of meningitis has largely or even completely disappeared Infection with the meningococcus by way of the ear may also occur now as before

Otitic abscess of the brain still occasionally causes death of patients Such lesions are now almost invariably "adjacent" lesions of the temporal lobe rather than the cerebellum In this group of cases, treatment with antibiotics was begun too late, or the infection was due to the presence of a resistant organism If this organism chances to be an anaerobic variety, the brain may be rapidly and diffusely invaded ("diffuse brain abscess") It has also become evident that after antibiotic therapy, certain pathological aspects of otitic abscess have become apparent which were rather uncommon before This altered picture of otitic abscess of the brain must be recognized, if the clinician is to keep pace with the changing situation

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SOUTH CAROLINA SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

Plans have been completed for a joint meeting of the North Carolina Eye, Ear, Nose and Throat Society and the South Carolina Society of Ophthalmology and Otolaryngology at Columbia, S C , on September 12, 13, and 14, 1955 Headquarters will be the Columbia Hotel

The following ophthalmologists will be on the program Dr E W D Norton of New York, Dr Frank Carroll of New York, and Dr William B Clark of New Orleans

An announcement of three guest otolaryngologists will be made later

A most attractive program has been arranged For further information address Roderick Macdonald, M D , Secretary and Treasurer, 330 East Main Street, Rock Hill, S C

SYMPOSIUM

INTRACRANIAL COMPLICATIONS OF OTITIS MEDIA AND MASTOIDITIS IN THE ANTIBIOTIC ERA

II Intracranial Complications of Otitis Media as Modified by Sulfa Drugs and Antibiotics—Clinical Aspects *†

J M NIELSEN, M D, (by Invitation),
Los Angeles, Calif

Before the advent of sulfa drugs and antibiotics students of intracranial complications of otitis media and sinusitis had worked out a system of diagnosis and treatment which was laudable. A study of the literature of the half century before the new era showed clearly that close attention and devotion to the patient with careful follow-up of changing symptomatology led the physician to a correct evaluation. The timing of surgical procedures was of great importance.

OTITIS MEDIA

The recognized complications of otitis media were

1 Mastoiditis

2 Epidural abscess

3 Meningitis

4 Extension to the lateral sinus and to the superficial cerebral veins with distant abscesses or softening

5 Thrombosis of the lateral sinus with its *a* Embolism *b* Labyrinthitis

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* Read at the meeting of the Western Section American Laryngological Rhinological and Otological Society Inc. Los Angeles, Calif. January 16 1955

† From the Department of Medicine (Neurology) U.C.L.A., and the Los Angeles General Hospital Los Angeles, Calif

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6 Temporal abscess

7 Subdural abscess

It was recognized that otitis media of infancy was common as an accompaniment of acute upper respiratory infections and of acute exanthemata and that it was usually bilateral It was known that extension to the mastoid process and to the cranial contents could occur from an ear which might clear, and hence, if one ear were involved when the patient was first seen, it might be the clear ear from which extension inward had occurred

There was a maxim among pediatricians which said, "When a child cries long without apparent cause, or if there is fever of undetermined etiology, think of the ears" It was known that, while chronic otitis media was more apt to extend inward, nevertheless acute otitis could also do so When a draining ear ceased to drain, the physician was not necessarily happy, because it might cease because of inward extension

In adults, otitis media was often unilateral and not as treacherous as in infants, but it tended to become stubborn and chronic from bacteroides infection

1 MASTOIDITIS

While mastoiditis is not actually an intracranial extension it is included here because it was a most common stepping stone to it, and because even uncomplicated mastoiditis often gave signs simulating intracranial extension When the authors of this little symposium were studying the neurological complications of simple mastoiditis it became evident that a meningeal reaction with increased deep reflexes of the opposite side and Babinski's sign were common All of the neurological symptoms and signs would disappear as soon as the mastoid abscess was drained

2 EPIDURAL ABSCESS

Epidural abscess was common with mastoiditis and would also give signs of meningeal irritation with pleocytosis, severe headache and reflex changes When mastoidectomy was routinely carried in to the dura (by the specialists in otology) and the abscess drained, the bottom would drop out of the neurological picture

3 MENINGITIS

Otitic meningitis was a dreaded complication and highly fatal, however, the diagnosis was difficult to establish, because many of the other complications would give rise to a meningeal reaction Neurological examination was not sufficient to state whether the meninges were actually infected, and reliance on laboratory work was necessary The finding of bacteria in the spinal fluid did not settle the issue, because they were found in meningeal reactions. Only a positive growth on culture established the diagnosis In meningeal reactions a clearing of the focal site would put an end to the meningeal syndrome.

4 EXTENSION TO THE LATERAL SINUS AND VEINS.

When infection extended to the lateral sinus the sinus did not always thrombose. There was a tendency for infection to extend to the superficial cerebral veins and cause distant cortical thrombosis with possibility of superficial cortical abscesses When intensive study of a case was carried out, with frequent spinal puncture, it was found that the fluid was temporarily blood tinged during the extension If this were not done, extension could occur undetected

5 THROMBOSIS OF THE LATERAL SINUS

Thrombosis of the lateral sinus was to be detected before the process reached the jugular bulb and the jugular vein. Of course needling of the sinus would disclose the thrombosis, but a spinal puncture with a Queckenstedt rise on jugular compression on one side only would show that the sinus was occluded When occlusion occurred it did not necessarily mean the dreaded embolism would develop The clot would have to disintegrate first however, fearing this, it was customary to ligate the jugular vein Thrombosis of the jugular bulb at times caused paralysis of the IXth, Xth and XIth cranial nerves.

Moreover, from a thrombosed sigmoid sinus, extension was common to the cerebellar veins with abscess and labyrinthitis Labyrinthitis gave rise to deafness and severe dysequilibrium with nystagmus and would simulate cerebellar abscess This would lead to all the vestibular and cerebellar tests Early choking of the discs was routine with cerebellar abscess, but not invariable Differentiation between cerebellar and temporal lobe abscess was often difficult, because the nystagmus and weakness of the two simulated each other

6 TEMPORAL ABSCESS

The formation of an abscess in the temporal lobe by direct extension in cases under continuous observation was recognized as occurring in three stages The acute first stage, of encephalitis, was comparable to influenza with a slight chill, fever, malaise, headache and anorexia but with a leucocytosis in the blood and a pleocytosis in the spinal fluid with polymorphonuclear predominance

In a few days this stage would subside gradually as the pus was walled off and the patient would feel greatly improved The second or latent stage would develop with cessation of fever, reduction of leucocytosis, change of spinal fluid cells from polymorphs to lymphocytes and gradual reduction of the cell count The latent stage was extremely deceptive and good clinicians as well as alert residents would occasionally discharge the patient as recovered

Then the third or manifest stage would appear with subnormal temperature, headache, changes in the eyegrounds, vomiting, perhaps aphasia or quadrantanopia—in brief, all the classical signs of a cerebral neoplasm, but with a history and adequate observation the otolaryngologist knew that the abscess was now ready for drainage Clinicians were astute observers and diagnosticians

7 SUBDURAL ABSCESS

Subdural abscess was a rare complication, but was recognized even in the last century Dr Macewen drained such an abscess associated with a cerebellar abscess and obtained a cure. A subdural abscess could spread over a large area and give a great variety of symptoms, but surgical diagnostic measures readily established a diagnosis.

Such was the state before sulfa drugs and antibiotics The clinician was a meticulous observer who studied his cases and systematized his knowledge with a view to accurate recognition of pathogenesis He knew what was going on at each stage, and it was the sequence of events that gave him his diagnosis

Now all this is changed The general practitioner does not make as careful a study of his case, because he has confidence in the antibiotic to subdue the infection regardless of site He tends to forget that trapped pus does not respond to antibiotics and that surgery is necessary for cure of purulent foci anywhere

The usual course of a case of cerebral abscess at present is as follows The patient complains of an upper respiratory infection and receives a massive dose of penicillin or some oral preparation of an antibiotic. He improves but is not well He complains of pain in the ear and receives another injection He does not get well but rumbles along for a week or two

Then vomiting appears and headache increases Observation having been poor, the doctor does not know what has developed but feels reasonably certain that any infection is removed He may not even call for otolaryngological consultation, but call a neurologist instead When examination discloses choking of the discs, and reflex changes, even he may think not of an abscess but of a neoplasm

The consultant has had the major part of his armamentarium removed, namely the sequence of symptoms and signs, because they have been clouded over to such an extent as to be unrecognizable. If he suspects an abscess he has no way to date its development. The case is virtually without a history, and objective diagnostic methods are relied on The surgeon wants an angiogram or air study, whereas in the past he would have tapped the abscess The time consumed in

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Antibiotics have thus reduced the number of intracranial complications of otitis media but have made the diagnosis when trouble appears much more difficult They have had a destructive influence on careful observations and intensive study They have brought with them a state of trust and confidence in the drugs which in turn lulls the observer into relative dullness The psychological effect on the physician has been bad Let him be alert to the fact that we still have complications hiding under a smog through which he must discern the diagnosis and effect a cure

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THE AMERICAN LARYNGOLOGICAL, RHINOLOGICAL AND OTOLOGICAL SOCIETY, INC, MEETINGS

SPRING

American Board of Otolaryngology
Richmond, Va, March 6-10, 1955

All Society Meetings will be held at the Hollywood Beach Hotel, Hollywood, Florida

American Laryngological Association.. ......March 13, 14, 1955
Triological Society ...(mornings only) March 15, 16, 17, 1955
American Broncho-Esophagological Association
(afternoons only) March 15, 16, 1955
American Otological Society, Inc ....March 17, 18, 1955

The Hollywood Beach Hotel (American plan) is a delightful place to hold the Spring Meetings — you may wish to bring the family along The Hotel offers its guests such features as ocean bathing, deep sea fishing, 18-hole golf course and country club, tennis and many other activities

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RADIOISOTOPES IN THE DIAGNOSIS AND TREATMENT OF HEAD AND NECK CONDITIONS *†

HENRY L JAFFE, M D ,

and

WARREN J ZAGER, M D ,

(by invitation),

Los Angeles, Calif

Radioactive isotopes have been administered internally in tracer amounts for various diagnostic purposes and in larger does for therapy Artificially produced radioactive material has been applied topically for the treatment of certain skin lesions and has been used externally in very large amounts for teletherapy machines or so-called 'cobalt bombs"

The intracavitary use of radioactive cobalt is similar to radium Cobalt is less expensive than radium and can be machined, therefore, it is possible to construct various applicators of this material that will more properly fit the physical needs of each case

Radioactive colloids have been injected interstitially, and radioactive seeds and needles have also been inserted into and about tumor sites The use of nylon threads containing radioactive substances has been reported The following briefly describes some of the special diagnostic and therapeutic applications of radioactive isotopes in head and neck conditions

DIAGNOSTIC USES

1 *Eye Tumors*

Neoplastic tissue contains a larger amount of nucleoprotein

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* Read at the meeting of the Western Section American Laryngological Rhinological and Otological Society Inc., January 16 1955

† From the Department of Radiation Therapy Cedars of Lebanon Hospital, and Department of Radiology (Therapeutic), University of Southern California School of Medicine Aided by research grants in memory of Roberta Flournoy Shaw Helen W Daniels and Mary Arnold

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than normal tissue The more rapidly the tissue grows, the more nucleoprotein will be present in the tumor When a tracer dose of radioactive phosphorus is injected intravenously, it is taken up in larger amounts by tumor tissue than normal tissue For this reason, it may be possible to detect the presence of an eye tumor by making readings over the eye with a specially constructed small Geiger counter which has an extremely thin end window

P^{32} uptake studies are valuable adjuncts to careful clinical evaluation of suspected eye tumors, rather than conclusive diagnostic tests Thomas, Krohmer and Storaasli[1] first described this technique in 1952 They found a positive uptake in five of eight patients, and each of these five patients proved to have a malignant melanoma of the retina

Krohmer, Thomas, Storaasli and Friedell[2] in 1953 reported their results in 32 cases A selective uptake was recorded as the ratio of the count over the suspected site to that over a normal portion of the eye They concluded that a selective uptake ratio of 1 4 or higher in the anterior segment is very suggestive of tumor, while a selective uptake ratio of less than 1 2 over the anterior segment strongly indicates a non-neoplastic process The uptake ratio for posterior tumors apparently was somewhat less reliable Included in this series were nine proved anterior tumors, three proved posterior tumors, and 14 non-neoplastic lesions Six cases were not tabulated, because a definite histopathologic diagnosis was not made

Bettman and Fellows[3] investigated the distribution of P^{32} in the eye after intravenous injection They found that the P^{32} is present in greatest concentration in the extra-ocular muscles, and is taken up in decreasing concentration in the choroid and retina, ciliary body, cornea, lens capsule and cortex, aqueous, sclera, vitreous, and least of all in the lens nucleus

In view of the fact that the vitreous, aqueous, lens and sclera are relatively inert and take up very little P^{32}, the count obtained over the eye is almost entirely from the P^{32} in the uveal tract and retina Great care must be taken to avoid the error of a false increased uptake of the tracer resulting from the placing of the tube over the rectus muscles of the eye

2 Brain Tumors

In 1949 Selverstone, Solomon and Sweet[4] described their technique of the localization of brain tumors during surgery by using a pure beta emitter, radioactive phosphorous (P^{32}) They found that the increased uptake of the P^{32} tracer was related to the increased amount of nucleo-protein in the brain tumor They employed a specially constructed Geiger counter shaped in the form of a needle probe which could be sterilized and then inserted directly into the brain tissue following craniotomy

When the patient was given a tracer dose of P^{32} intravenously, the needle probe counter could detect the increased uptake of P^{32}, which ranged from 6 to 110 times greater in brain tumors than in normal white matter Although the uptake of P^{32} in the gray matter of the brain was somewhat greater than that of white matter it never approached the high degree of uptake in tumor tissue

Ashkenazy, Davis and Martin[5] in 1950 reported their technique of localizing brain tumors with the aid of radioactive diiodofluorescein It is believed that the increased radioactivity in the tumor site is due to the change in the blood brain barrier which permits a greater concentration of the tracer substance in the tumor site

In 340 patients suspected of having central nervous system tumors they found only 17 proven inaccuracies in their test, making a total accuracy of 95 per cent. They gave the patient an intravenous injection of 1 millicurie of radioactive diiodofluorescin tagged with I^{131}, and then made readings over the entire skull with a heavily shielded Geiger counter

Human serum albumin tagged with I^{131} has also been used and this isotope appears to be more satisfactory because it is more stable, thus making possible recheck examinations in the same patients for as long as one to three days after the initial injection of the isotope tracer A shielded scintillation counter, which is many times more sensitive than the Geiger counter is now used, making it possible to detect the gamma rays coming from the tracer It has also been possible to detect some metastatic brain tumors by this method

The brain tumor test should not be performed immediately after trauma or soon after certain diagnostic X-ray procedures, such as angiography There may be a change in the blood brain barrier as a result of this trauma which might result in a false positive uptake of the tracer material Usually the more anaplastic brain tumors and the more vascular neoplastic lesions take up the greatest amount of the radioactive material

Benign lesions may show very little uptake, and cystic lesions may actually show a decreased uptake as compared to the normal tissue on the opposite side of the brain A positive test should show an increase of more than 15 per cent in the uptake of the tracer material in the suspected area as compared to the corresponding area on the opposite normal side of the brain This increased uptake should be detectable on repeated examinations made several hours apart Subdural hematomas may sometimes give readings which simulate those of brain tumors

In 1951 Sweet[6] described a method using radioactive postasium (K^{42}) This isotope emits gamma rays and was found to concentrate extremely well in brain tumors Since it also concentrates in muscle tissue, its use must be restricted to tumors located in those portions of the skull not covered by thick layers of muscle

More recently Sweet and Brownell[7] have described the use of arsenic^{74} for the localization of brain tumors This material concentrates in a ratio of 5 to 1 in brain tumor tissue over normal brain tissue Thus, if the neoplasm does not present itself on the surface of the brain nor distort the convolution sufficiently to allow its detection after the dura has been opened, it is possible to attempt radioisotope localization by inserting the fine probe-type Geiger counter into the brain tissue This probe measures about 2mm in diameter This type of localization makes it possible to prevent extensive mutilation of brain tissue by surgical exploratory means

We agree with the recent report of Seaman[8] that the clinical status of this test is yet to be definitely determined, however, we feel that it is a useful screening procedure to aid in the selection of patients for further diagnostic studies The failure to localize a brain tumor may be the result of an unfavorable location, or biological characteristic that interferes with the basic mechanism of localization of the medium

3 *Thyroid Disease*

One of the earliest and most commonly employed isotope tracer techniques has been the use of radioactive iodine for

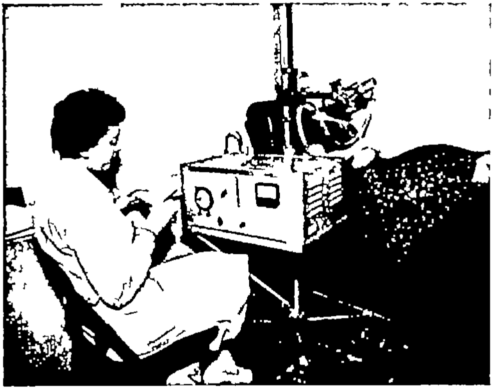

Fig 1.

the study of thyroid function (see Fig 1) In 1950 we reported that this diagnostic test proved to be more accurate for the study of thyroid function than the basal metabolism test and the protein bound blood iodine test. The thyroid gland normally concentrates iodine in a proportion of at least 2,000 to 1 over any other tissue of the body

When this iodine binding power is decreased due to thyroid disease or as a result of surgical removal of the gland there is a detectable decrease of the amount of uptake of the radioiodine tracer When the thyroid gland is overactive, the uptake of the tracer dose of radioiodine is usually above normal limits, thus a measure of the amount of radioiodine uptake or concentration by the thyroid gland along with the clinical study of the patient is an excellent means for determining whether thyroid function is low, normal or high

The authors routinely follow the 24-hour thyroid uptake study by a 48-hour scan of the thyroid area to make a "thyrogram" (see Fig 2) A normal picture shows a uniform uptake of the tracer in both lobes in average amounts No "cold" or "hot" spots are seen (see Fig 3)

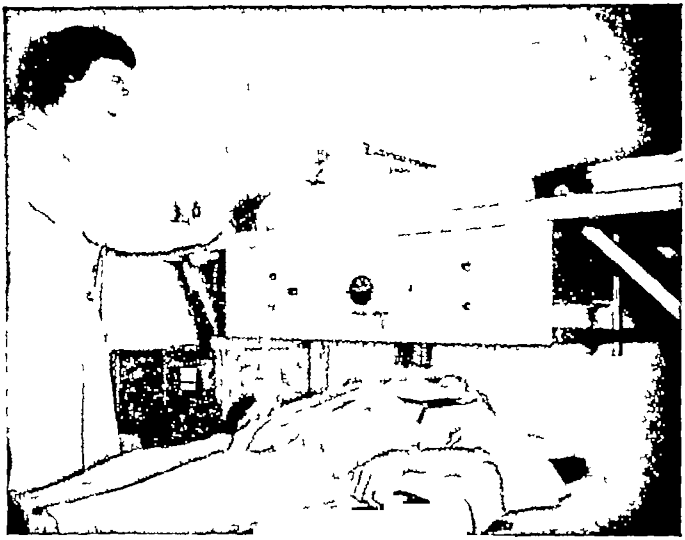

Fig 2

When the gland is overactive the thyrogram picture is very dark In the case of hyperthyroidism, or Graves' disease, both lobes are usually involved and show a diffusely increased uptake throughout, and may actually be increased in size (see Fig 4) In myxedema the uptake is very low in both lobes (see Fig 5)

Occasionally, a single toxic nodule is found in one lobe

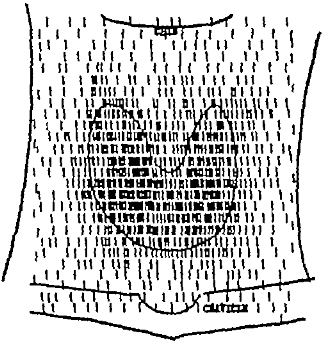

Fig 3.

which interferes with the function of the normal lobe (see Fig 6A-B)

Following total thyroidectomy for carcinoma of the thyroid gland, a scan over the neck may show no uptake (see Fig 7), however, 24 hours after an intramuscular injection of thyroid stimulating hormone (TSH) the test is repeated, and an uptake may be demonstrable in residual thyroid tissue (see Fig 8)

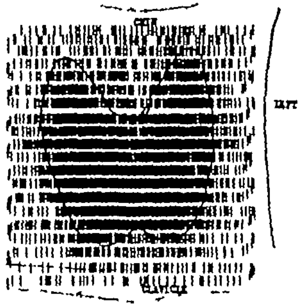

Fig 4

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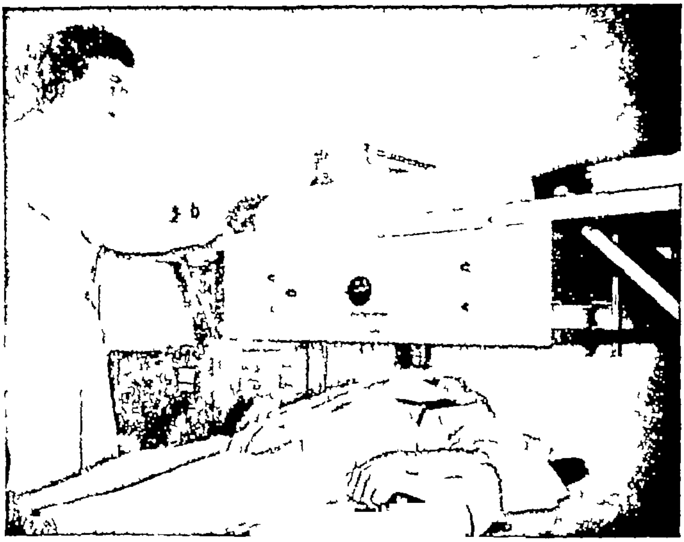

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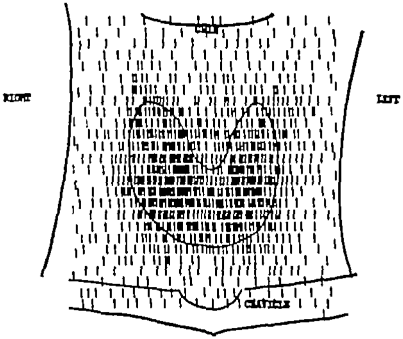

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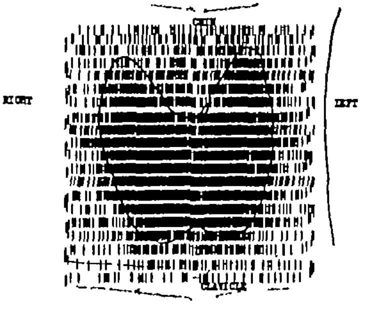


Fig 4

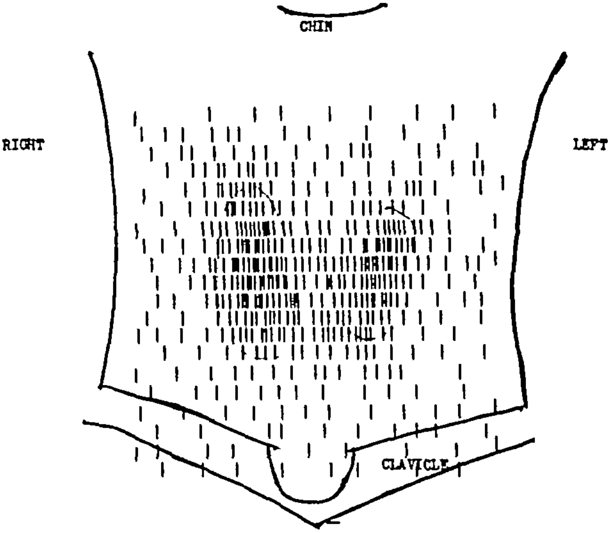
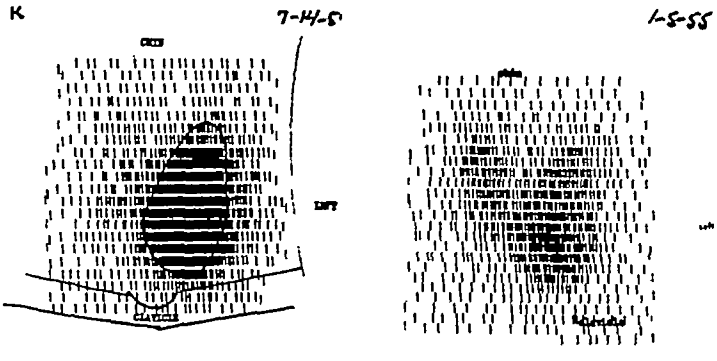


Fig 5



A

B

Fig 6

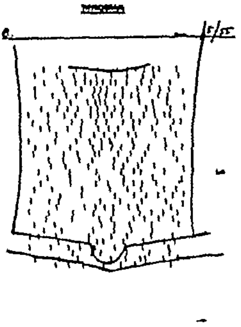


Fig 7

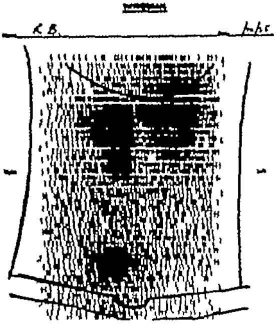


Fig 8.

In 1954 our group[10] reported the use of a tracer dose of radioactive iodine to help establish the diagnosis of a posterior mediastinal goiter

The thyrogram also helps determine the function of single

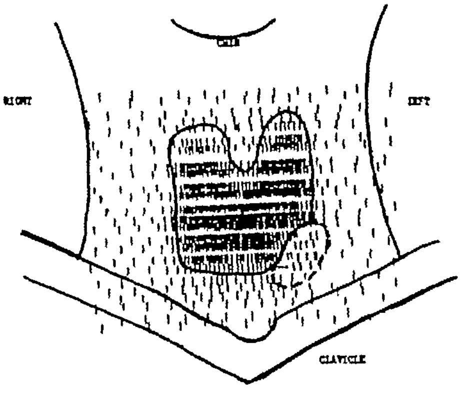


Fig 9

or multiple nodules in the thyroid gland If a single nodule or multiple nodules fail to take up radioactive iodine, it is termed a "cold" nodule (see Fig 9) This, therefore, represents nonfunctioning or poorly functioning thyroid tissue and may indicate the presence of a neoplasm, a nonfunctioning adenoma, an area of thyroiditis, or a cyst A biopsy is usually advised for these "cold" nodules, and appropriate surgical treatment is carried out if maligancy is found

If a nodule takes up a large amount of radioactive iodine it represents a hyperfunctioning nodule which usually is benign

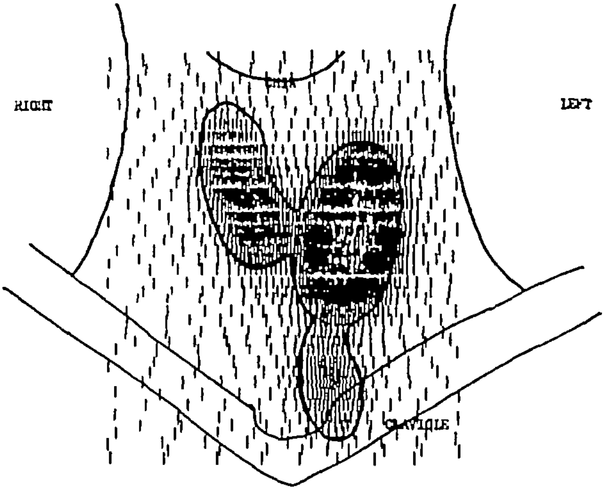


Fig 10

The presence of carcinoma in this type of "hot" nodule is extremely rare If the uptake of the I^{131} tracer is high, it is possible to destroy this "hot" nodule by radioactive iodine If, after radioiodine therapy, the follow-up thyrogram shows that there is a residual nodule which takes up very little radioiodine, then surgical intervention is indicated

Post-thyroidectomy recurrent thyrotoxicosis may be detected by the thyrogram and the extent of the regenerated thyroid tissue visualized (see Fig 10) Following radioiodine treatment, the return of the gland to more normal status

may be followed by the post-treatment thyrogram (see Fig 11) In acute thyroiditis a very low uptake of the radioiodine tracer is found A thyroglossal cyst shows an absence of uptake of radioiodine in the cystic area

When a lingual thyroid is suspected clinically, the thyrogram will usually demonstrate the aberrant thyroid tissue in the tongue (see Fig 12) A negative uptake of the radioiodine tracer will help exclude the possibility of the lesion being of thyroid tissue origin

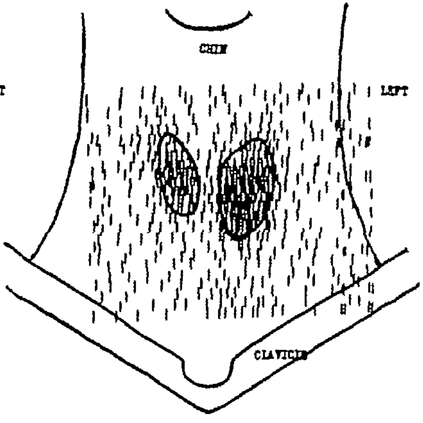


Fig 11

Substernal thyroid tissue may be demonstrated by both the uptake of radioiodine and the scintiscanner picture (see Fig 13) When so-called lateral aberrant thyroid tissue is clinically suspected in the cervical region, an uptake study and a scan of the neck may help confirm the presence of thyroid tissue metastasis, however, since many of these tumors show pure papillary structure histologically, they usually do not concentrate radioiodine The alveolar and the follicular thyroid neoplasms are the ones which concentrate radioiodine to the highest degree, and the mixed papillary thyroid tumor may concentrate some radioiodine.

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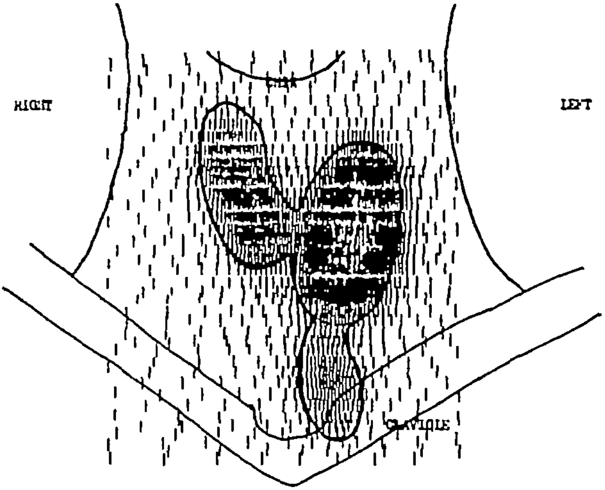

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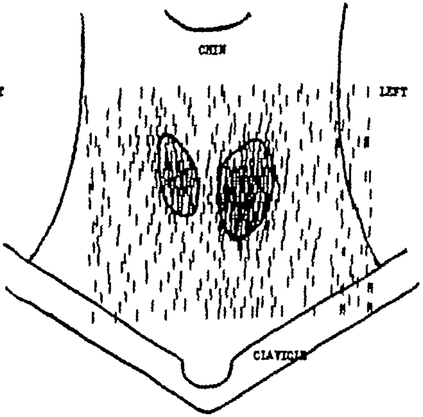

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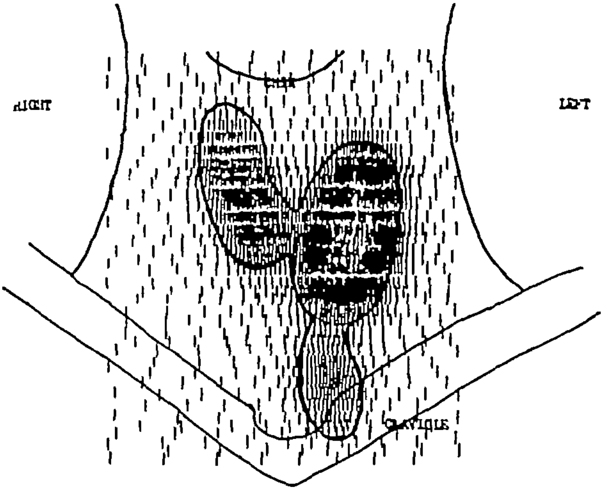

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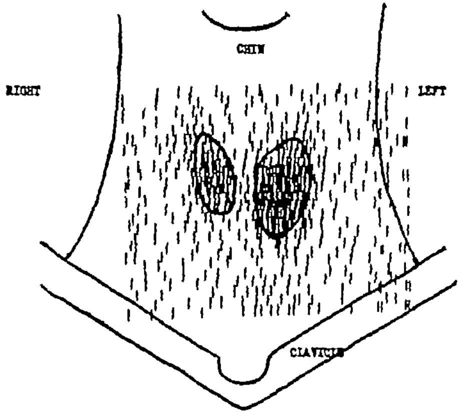

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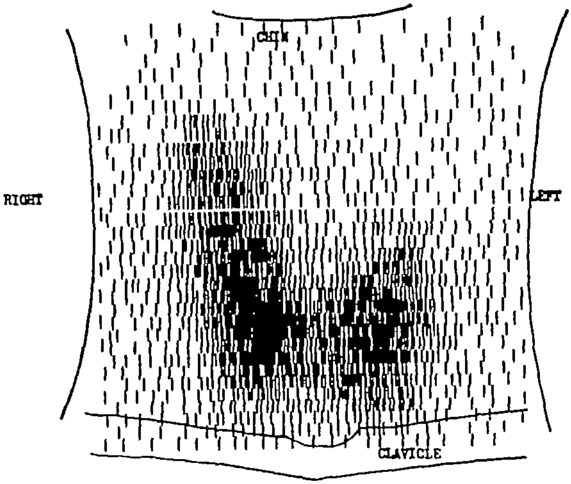

Fig 12

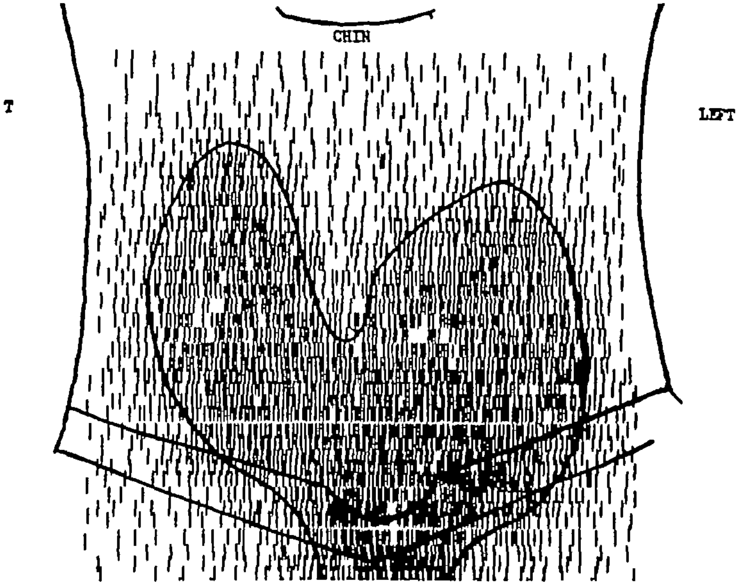

Fig 13

THERAPEUTIC USES

It is well known that the biological effect of nuclear radiation is due to ionization The therapeutic value of such radiation depends upon increased sensitivity to ionization of diseased cells, and thus their preferential destruction over normal cells, it also depends on the fact that after the partial or complete destruction of tissue cells the recovery mechanism of tissue is such that predominantly normal cells will be regenerated

Radioisotopes have been useful in the treatment of certain benign conditions, such as thyrotoxicosis, and have also contributed to cancer therapy during recent years The results in cancer therapy cannot be finally evaluated, since there has not been enough time for long term statistical evaluation The palliative benefit of radioisotope treatment in certain types of cancer has been striking

Therapeutically, radioisotopes may be administered internally or may be placed externally as a radiation source For internal use two modes of placement are available namely, biochemical and physical An example of biochemical placement is where the host organ, such as the thyroid gland, shows a special affinity for the radioisotope because the thyroid gland uses iodine in its normal metabolism

The uptake of radiophosphorus by nucleoprotein in tumor tissue is another example of biochemical placement. An example of physical placement is the interstitial use of radiocolloids for the treatment of tumors External use of radioisotopes includes surface application by plaques or other applicators, and by beam irradiation by teletherapy units

1 Eye Disease

Strontium^{90} is a fission product, and when made up into a plaque for the treatment of eye lesions is an excellent source of pure beta radiation with two continuous spectra namely that of strontium^{90} and yttrium^{90} It has a physical half life of 20 years Friedell, Thomas and Krohmer[11] in 1950 reported that strontium^{90} beta rays had the same biological effectiveness when applied clinically as the beta rays from radon which had been used in a similar series of cases All treatments with strontium^{90} must be given by direct contact, since this is the only manner in which the actual dose to the tissue can be carefully regulated

This applicator has been useful for the treatment of superficial diseases of the eye, such as small benign tumors, especially papillomata of the lids and conjunctiva, Bowen's disease or intra-epithelial epitheliomas, angiomata of the lids and conjunctiva in infants, and pterygia Early cases of vernal conjunctivitis often show an excellent therapeutic response to beta radiation

Vascularization of the cornea is another condition which may be successfully treated Vascular obliteration has been favorable after superficial keratectomy, and as a preliminary procedure to corneal transplant where there are invading vessels of the cornea Treatment has also been given following corneal transplants where there is a possibility of vessels reinfiltrating the graft from the surrounding cornea In vascularized corneal leukomas, associated with irritability, and in chemical burns of the cornea, great relief may be obtained by beta radiation

Certain forms of chronic ulcer of the cornea have healed after beta radiation therapy has been applied to the limbal region directly adjacent to the ulceration The dosage at the surface of the eye where the applicator makes contact with the tissue is 100 per cent, and because there is only beta radiation the dosage rate drops off rapidly, so that at 3 mm depth there is only 12 per cent of the surface dose present This minimizes the danger of producing a radiation cataract of the lens

2 *Brain Tumors*

A cobalt teletherapy machine (see Fig 14) has been developed through the cooperative effort of the Teletherapy Evaluation Board of the Oak Ridge Institute of Nuclear Studies This type of machine has recently been installed at the Cedars of Lebanon Hospital in Los Angeles, and it contains 1066 curies of radioactive cobalt^{60} Cobalt^{60} has a half-life of 5 3 years, gives off a very strong gamma ray equivalent to the output of a 3,000,000 volt X-ray machine

It is possible to deliver large doses of radiation to inoperable brain tumors without producing the intense reaction in surrounding normal tissues which we formerly observed with conventional deep X-ray therapy The addition of rotation therapy techniques permits the delivery of a large axis tumor

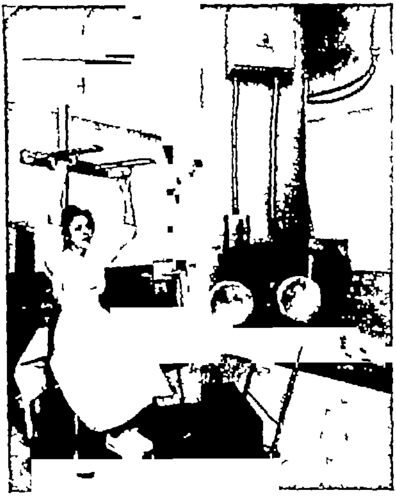

Fig 14

dose without producing severe skin and bone reactions, and with a minimum of radiation sickness

In order to deliver intensive radiation directly to the tumor site, we have injected radioactive colloidal chromic phosphate (P^{32}) locally at the time of surgery when we have found an inoperable brain tumor We have developed a special syringe with a plastic shield which protects the operator during the injection treatment (see Fig 15)

The radioactive phosphorous (P^{3}) is a pure beta ray material which acts locally over a range of only a few millimeters This prevents destruction of adjacent normal tissue Radioactive gold^{198} in the form of seeds or wire may also be introduced into the tumor tissue in much the same manner as radon seeds The short half-life of radiogold, 2 7 days, presents a practical problem since the material may not be available when it is needed The longer half-life of chromic phosphate, 14 3 days, makes it possible to have this material on hand for use in the operating room at all times

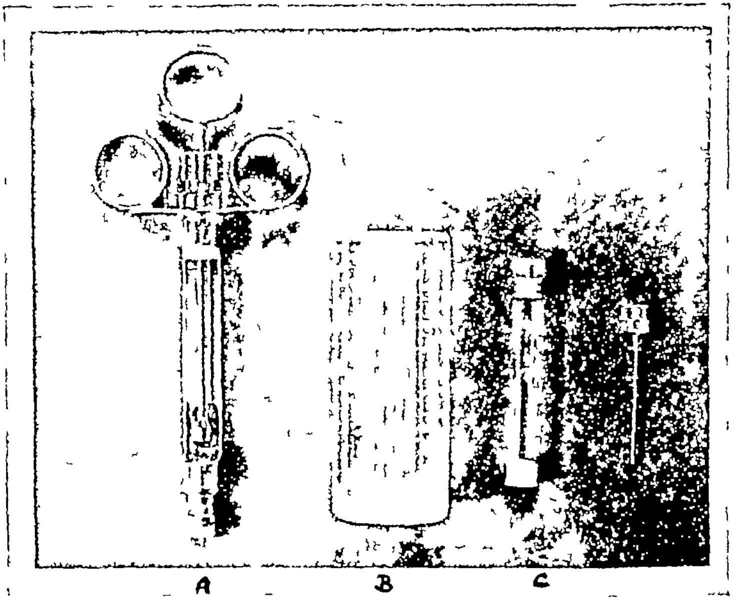

Fig 15

3 *Nasal Cavity and Paranasal Sinuses*

It is possible to use radioisotope needles, tubes, beads and specially constructed applicators These may be inserted after surgical exploration, and the larger variety of shapes and sizes available facilitates a more homogeneous distribution of the radiation sources The intracavitary therapy may be followed by external radiation with the cobalt teletherapy apparatus The advantage of this combination of isotope treatment is that a maximum amount of tumor dose may be given with a minimal danger of postradiation bone necrosis and atrophy of the skin and mucous membranes

4 *Tumors of the Tongue, Floor of the Mouth and Palate*

In addition to using radiocobalt needles, or radiogold seeds, it has been possible to inject radioactive colloidal chromic phosphate for the local destruction of tumor tissue The preliminary work looks hopeful, but it will require a longer term of observation for evaluation The cobalt teletherapy machine is also used for external radiation in place of the conventional deep X-ray therapy at 200 250 KV

Henschke, of Ohio State University Medical School, has recently described the use of iridium^{192} in nylon ribbons for the irradiation of soft tissue tumor masses Multiple small seeds of the isotope are held in place in fine nylon ribbon The ribbon is sutured in various planes to encompass the entire neoplasm The iridium nylon material is more comfortable for the patient than the introduction of rigid radioactive needles and tubes and, therefore, is particularly useful for lesions of the tongue and soft tissues of the mouth.

5 *Nasopharynx, Larynx and Esophagus*

The use of teletherapy with large sources of cobalt^{60} makes it possible to obtain a high energy output of radiation simulating the super-voltage of 3 000,000 volt X-rays This permits rotation therapy techniques, which should afford the advantage of delivering adequate cancerocidal doses without the dangers of postradiation sequelae noted with conventional deep X-ray therapy It is too early to evaluate and compare the results of this form of radiation therapy with conventional X-ray therapy however, with the use of the newer radiation techniques, there is a theoretical basis for optimism

The use of specially constructed phantoms permitting accurate determination of tumor dosage, will assure the delivery of the necessary lethal dose of radiation to the tumor The use of fluoroscopic screens and television cameras during rotation therapy, together with the remote control apparatus of the rotation chair, will permit the continuous accurate placement of the patient and the delivery of the radiation in a more precise manner This may also have a favorable effect on the end results

6 *Thyroid Disease*

Radioactive iodine (I^{131}) has a physical half-life of eight days We have used it successfully in more than a thousand patients for the treatment of hyperthyroidism It is given orally in one or more doses The results of radioiodine therapy are as good as those previously reported for thyroidectomy

In the treatment of carcinoma of the thyroid gland, the biochemical placement factor unfortunately holds true in only about 10 to 15 per cent of all of these cases The pure papillary form of carcinoma of the thyroid gland does not take up very much radioactive iodine, therefore, it has no value in the treatment of this type of thyroid cancer The mixed papillary and follicular histological types, as well as the alveolar type of thyroid cancer, do take up radioiodine, and, therefore, better results may be expected

We routinely recommend that a tracer dose of radioiodine be given to each patient prior to thyroid surgery, so that when the pathologist finds the presence of thyroid cancer we have an opportunity to make a radioautograph of the removed tissue The radioautograph shows us whether or not the tumor cells take up radioiodine, and helps settle the question of whether radioiodine treatment will be of therapeutic value for each case

A total thyroidectomy and neck dissection should be the primary form of treatment where indicated for thyroid cancer, and radioiodine should be used as a postoperative therapeutic measure when indicated

A recent report by Black, Woolner and Blackburn[12] reviewed 128 cases of carcinoma of the thyroid gland in which radioiodine was employed diagnostically or therapeutically Twenty of 23 lesions classified as the follicular type of papillary adenocarcinoma, or as either the follicular and mixed follicular and solid type of malignant adenoma, concentrated iodine or could be stimulated to do so by ablation of the functioning thyroid tissue and the administration of thiouracil Fourteen of 28 cases of mixed follicular and papillary type of adenocarcinoma accumulated iodine to variable degrees

The papillary type of papillary adenocarcinoma, solid and Hurthle-cell types of malignant adenoma and anaplastic adenocarcinoma almost never concentrated nor could they be stimulated to concentrate iodine Following thyroidectomy we advise the removal of any remaining thyroid tissue by treatment with radioiodine

The primary purpose of this total ablation is to remove the inhibition of function of any possible foci of thyroid malignancy This may make it possible to detect functioning metastatic thyroid lesions by the administration of tracer doses of radioiodine followed by scanning of the entire body with a Geiger counter or scintillation counter If a positive uptake is found in a metastatic focus then radioiodine treatment is administered

7 *The Neck*

Metastatic carcinoma to the lymph nodes of the neck may be treated by radioisotopes when there is an indication for radiation therapy Radioactive cobalt in needles, radiogold in seeds, iridium in nylon threads, and injectable radiocolloids represent more flexible means of applying radiation therapy than was previously available with radium needles or radon seeds

Because the original cost of the isotope is much less than an equivalent amount of radium, it is possible for each institution to have a greater variety of radiation materials available for the physical placement of this type of treatment. It is also possible in certain cases to give additional external radiation therapy by means of the cobalt teletherapy machine after a maximum amount of external radiation has been given with a conventional deep X ray therapy machine Occasionally, this added treatment will result in more palliative benefit for the patient. The availability of radioisotopes for the treatment of neck cancer has not changed the indication for radical neck dissection

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COURSE IN LARYNGOLOGY AND LARYNGEAL SURGERY

The next course in Laryngology and Laryngeal Surgery to be given by the Temple University School of Medicine is scheduled for March 28 to April 8, 1955, under the direction of Dr Chevalier L Jackson

GLOBUS *

MEADE MOHUN, M D ,†

San Mateo, Calif

Globus is a condition that is described as a feeling of a lump in the throat on swallowing, which is purely subjective. The older descriptions of globus always describe this as an *hysterical* phenomenon Hysteria is defined as a symbolic expression of an emotional conflict Today, many pathological conditions are known to be capable of giving a sensation of a lump or an obstruction in the throat and must be carefully ruled out, but it remains true that the great majority of patients with such symptoms have no organic basis for them

Some of the organic conditions occasionally associated with the globus symptoms and always to be kept in mind are

1 It is felt by some observers that an acute tonsillitis, lingual or faucial, acute pharyngitis or laryngitis, causing hyperesthesia may leave in its wake areas of anesthesia which give rise to a sensation of a lump This sensation (neuritis) may also follow a temporary lodging of a chicken or fish bone and may persist, in a sensitive individual, and focus the patient's attention on the throat long after the foreign body is removed

2 Hyperplasia of lymphoid tissue following an acute infection, especially in the lingual and lateral pharyngeal areas, may persist and become noticeable to the patient. Some believe this is more apt to occur if a prominent cervical vertebra is present in this area

3 Atrophic changes in the pharynx accompanied by anemia usually in middle-aged women, described by Vinson[1]

4 Webs at the entrance of the esophagus, described by Mosher[2]

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* Read at the meeting of the Western Section American Laryngological Rhinological and Otological Society Inc. Los Angeles Calif., January 16 1955.

† Division of Otolaryngology Division of Surgery of Stanford University School of Medicine.

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through the glandular chain, in this way humoral control is exercised over the body and personality

2 The other pathway is through the peripheral autonomic pathways with definite nuclear centers If there are not too many uncontrollable emotional responses from the frontal lobe to the hypothalamus, and if the hypothalamus is a rugged receptor and capable of sending out balanced responses, then the resulting peripheral expression via the pituitary and the autonomic system remains coordinated, and the patient will feel correspondingly well, but if a disorganized peripheral response occurs as a result of undue environmental stimuli, and with which the patient's hypothalamus cannot cope, then either an acute or chronic disturbance of some end organ may occur

In our own practice of otolaryngology, this may occur in the nose, as in vasomotor rhinitis, in the ear, as Meniere's and the various pseudo-Meniere syndromes, in the throat as globus, in the head as cephalgias and migraine, in cranial nerve involvements as in facial nerve paralysis, etc

This control, or disordered control, is carried out by neurovascular, neuromuscular and neurosecretory mechanisms

When there is excessive sympathetic stimulation, it may result in end-artery spasm End-artery spasm may also result from antigen-antibody reaction in the smooth muscle sphincter, bringing allergy into the picture The end-artery spasm throws out the delicate balance between the artery-capillary-venule system Passive dilatation of the capillary venous network occurs, sludging of the blood takes place, and there is extravasation of transudate into the surrounding intravascular spaces Such localized edema may be one source of the sensation of globus

In addition to the effect on neurovascular control, these excessive sympathetic stimuli may affect the peripheral neuromuscular mechanism, resulting in spasm of the pharyngeal-esophageal musculature, more especially the crico-pharyngeus, from which a sensation of globus will result

Accepting the above cause, that is disordered hypothalamic response as providing the answer to many of these cases of globus, the *ones with no demonstrable pathology led to the* trial use of Rauwiloid drugs It is in this type of case where we have simple, emotional tension, or anxiety and fear, that the effect of the Rauwiloid drugs has been so efficacious In the deeper psychoses, it works the same way, namely, in relieving the anxiety tension rather than the basic delusions confusions or hallucinations Serpasil or Seserpoid appeared *to be the extract most suitable for this work Plummer*[5] *and* associates have stated that the action of Serpasil may be due to a protective influence which the drug provides for the central autonomic centers against stimulations of various types coming from peripheral or frontal cortical areas, a partial suppression of sympathetic predominance at the hypothalamic level

During the past year, 80 patients complaining of the symptoms of globus were treated by the drug Serpasil All of these cases were first carefully checked over to eliminate organic pathology They were all given a complete physical check by the internist, as well as by the laryngologist. All had barium studies, and a certain number had endoral examination

Of these 30 cases, eight had more than the usual amount of lingual tonsil These cases had the lingual tonsils reduced in size by the use of a curved electrode and diathermic destruction No particular improvement in the symptoms of globus was noticed *in six of the patients. Two of the patients felt* there was some improvement. Six other patients had diathermic destruction of hypertrophied lymphoid tissue on the posterior wall Five of these patients showed no particular improvement of the symptom of globus, one felt improved Approximately 35 per cent of these 80 cases showed lipping of the anterior borders of the cervical vertebra

A series of lateral X-ray studies of the neck in patients of approximately the same age bracket was studied These patients all had complaints other than globus The percentage of vertebral lipping was essentially the same in both series

Of the 80 cases treated with Serpasil six were lost track of and could not be followed further, 24 were followed closely, five of the cases showed no definite improvement Of these five cases, one exhibited marked nasal stuffiness, and we had to discontinue the medication Two cases had symptoms which were not definitely those of globus Their symptoms were multiple and fleeting, and these patients were not sure they were helped

Two cases showed marked psychotic disturbances, and these were referred to a psychiatrist The remaining 19 cases showed rather marked improvement, to complete cure Patients who had lipping of the vertebrae were all relieved of the sensation of globus by the use of Serpasil, also the patients who had hypertrophied lymphoid tissue, either of the lingual or pharyngeal areas and were not relieved by removal of this tissue, were helped by the drug

Most of these patients are still taking the medication in doses ranging from 0 1 mg to 0 5 mg per day, and remaining mostly free of this complaint

These patients have likewise appeared greatly improved in their general outlook, in spite of the fact that most of them still have considerable emotional or physical stress to combat in their daily living A number of these patients take the drug on and off according to their symptomatology and their life stress situations

As to why some people respond to stress and strain with such a symptom as globus while others respond entirely differently, is difficult to answer Quoting from L G Moench,[6] "One of the puzzles in psychosomatic medicine is syndrome selection, why certain people develop one syndrome and others develop a different one, why one person gets asthma, another ulcers, another, hypertension, and a fourth, ulcerative colitis, etc. Social and economic position may influence the choice of disease"

Three cases of rather typical migraine with hereditary history have been treated by this drug Two of the cases with weekly bouts of migraine have held their headaches in more or less complete check for over six months In order to do this, it has been necessary to work the dosage back and forth to obtain the minimum dosage required to keep the headaches in abeyance, and to allow them freedom from undue lessening of their normal drive. A third patient has an occasional bout of ophthalmic aura, but this is not followed by the headaches as a rule, and usually one aspirin will relieve this quickly

Aldrich[7] speaks of environmental modification, clarification insight development and psychological support as being most essential in overcoming neurotic and emotional problems With the marked lessening of the apprehension and tension of a patient, by the use of Serpasil, the patient puts himself in a much better position to develop and utilize these steps out of his problems It is in such a role that the use of the drugs of the Rauwolfia family are offered for further study

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COURSE IN RHINOPLASTY, RECONSTRUCTIVE SURGERY OF NASAL SEPTUM AND OTOPLASTY

An intensive postgraduate course in Rhinoplasty, Reconstructive Surgery of the Nasal Septum and Otoplasty will be given July 16, 1955, to July 30 1955 by Dr Irving B Goldman and staff at The Mount Sinai Hospital, New York City, in affiliation with Columbia University

Candidates should apply to Registrar for Postgraduate Medical Instruction, The Mount Sinai Hospital, 5th Avenue and 100th Street, New York 29, New York

AN INQUIRY INTO CURRENT CONCEPTS OF VISUAL SPEECH RECEPTION (LIP-READING) *

JACQUELINE KEASTER, M S ,

(by Invitation)

Los Angeles, Calif

Most of us from time to time see patients with handicapping hearing losses that are not ameliorated to any extent by the use of a hearing aid In some instances it is because of the contour of the loss, in other cases, the extent of the impairment is so great that the most powerful aid can serve only to bring the wearer some slight awareness of environmental sounds, and in still other situations the presence of recruitment tends to make amplified sound uncomfortable even to the point of its being painful

Under such circumstances, we tell the hard-of-hearing person, rather glibly sometimes, that he must learn lip-reading Some patients follow our advice, they learn lip-reading even to the extent that the untutored may question whether the patient is really hard of hearing or only pretending to be On the other hand, there are other patients with comparable losses who, try as they will, never really learn to read speech with any facility Some of them have taken lip-reading instruction over a long period of time and have spent a great deal of time and practice with very little improvement in their lip-reading ability

Observations of this nature are made frequently in clinical practice, and very often in schools for the deaf and hard of hearing, but little is known about why or what the factors are influencing this difference in skill Historically, the teaching of lip-reading dates back to about the middle of the 17th century in Europe, when the old records state that the deaf man was taught "to listen with his eye "

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The first school which taught lip-reading to children in this country was opened in Northampton, Massachusetts, in 1867 Little is known about the lip-reading methods employed in that teaching

It was not until about 1912 that mention is made in the history of the education of the deaf and hard-of-hearing, of adults being taught to lip-read as early as 1882, but it was not until the early 1900's that there was any specific teaching of lip-reading to the adult hard-of-hearing patient. Three so-called methods of teaching the skill came into being about that time. The methods were based on the then current notions concerning the teaching of reading one was highly anlytical, it began with the syllable, proceeded to the word, from the word to the sentence and from the sentence to the story Another started with the story and broke it into its parts, and the third method purported to be a combination of the other two

Hard-of-hearing people took what were called "normal training courses" in a method of teaching and set themselves up as private teachers of lip-reading There was a tendency on the part of these people to adhere with a tenacious grip to the tenets of the method advocated, and never to question why a patient succeeded or failed to learn.

No new method of teaching was introduced until 1927, when the Jena method was brought from Germany and introduced at the Northern Michigan College of Education in Ypsilanti Since that time, there have been adaptations made of the various methods, but very little scientific inquiry concerning why some people learn to lip-read with comparatively little effort and despite or because of any method of teaching, while others never do learn to follow speech with any facility regardless of their background and education or their native intelligence.

Several years ago in order to begin to investigate something of why this takes place, we made up a set of 15 colloquial sentences Moving pictures were then taken of a young woman speaking the sentences in a normal voice The resultant film was then shown, without a sound track, to a group of 40 college students with normal hearing Using such a group for the experiment it was possible to control a number of variables intelligence, age, and most of all, training No one of the 40 had had any training in lip-reading or, for the most part, even knew what it was

If credit was given for parts of sentences read correctly, a possible score of 96 points could be earned on the material The scores at the conclusion ranged from 8 to 94 points, with a clustering of scores around 30 points In order further to check our observation, we tried the sentences with two young women, then students in the university, who were hard-of-hearing One, to all intents and purposes, was totally deaf and lost her hearing with meningitis when she was a senior in high school The other was girl who had been severely hard-of-hearing from birth

The first girl made a perfect score on the sentence, the second scored only 36 points The latter had been virtually dependent upon lip-reading for purposes of communication all of her life and had lip-reading instruction since she was a little girl The other student lost her hearing only two years before and had very little instruction compared to the other person yet she made a significantly higher score on the material The difference between the two is not unlike that of the range of scores of the 40 students with normal hearing who had no lip-reading instruction

At best such material as was shown only roughly simulates a live conversational situation A film of this sort is more difficult because of its lack of situational cues, occasional sound, gesture and so forth, but it gives you some idea of what confronts the hard-of-hearing person when he attempts to understand speech by attentively watching the speaker

When we stop to consider spoken language, we realize that it is made up of a rapid succession of over-lapping syllables that are in turn comprised of some 40-odd sounds of varying degrees of visibility The lip-reader must be able to recognize instantly all of the visible movements and fill in those that are invisible Only about 30 per cent of the sounds of English speech are in the former category, all the other sounds are hidden in the mouth, or look like one or two other cognate sounds

For example, the sounds *p*, *b*, and *m* sound different one from the other, but they look exactly alike Ideas must be grasped in a fleeting instant, speech is never static. It is a constantly moving change of syllables No two mouths are alike and no two individual speech patterns are identical All this we know, but what we do not know is what factors account for the wide range in the ability of people to lip-read

The old books dismissed it in some such fashion as this 'Results in lip-reading, it goes without saying, vary greatly depending upon the student's type of mind and in general upon his character" Actually that does not say very much beyond the fact that a patient learns to lip-read, or he doesn't

In 1944 Utley reported a study done with 761 deaf and hard-of hearing individuals enrolled in schools or societies for the acoustically handicapped in four large cities The material used consisted of 100 words, 70 sentences and six short stories spoken by university students using what was considered to be average American speech It was filmed in order that all the subjects saw exactly the same material

The validity of the test was established by its logical derivation as a representative work sample from everyday life and by the high reliability resulting from the inter-relationships of the test material The results showed Lip-reading ability cannot be predicted by reading level or school achievement lip-reading ability cannot be predicted from chronological age age of onset of deafness or grade placement It was also found that it is not possible to arrange test items in the order of their difficulty Our observations would point to the possibility that there is not a high correlation between lip reading and general intelligence

Up to this time most of the investigative work that has been done in the field of lip-reading has pointed toward the standardization of test batteries that would test lip-reading ability, but nothing has been done to specifically investigate factors which influence the acquisition of that skill We have therefore prepared a set of materials consisting of six sets of 120 sentences each spoken by six different speakers, three men and three women

We propose to start our test situation by showing the material to a group of approximately 50 normally hearing university students in order to eliminate those sentences that do not discriminate, *i e*, those that are too easy and those that a majority fail This preliminary run should also show up any gross differences between speakers In that way we hope to eliminate enough material to make this work sample useful in terms of length

We then propose to try the material with another group of normally hearing students and at the same time administer a wide battery of psychological aptitude tests along with projective tests of personality Comparable batteries should be set up at the same time with a group of hard-of-hearing adults who learned speech and language normally through their ears, *i e*, we want to keep the deaf and the hard-of-hearing groups separate

In Group 1 it will be possible to control, at least to a degree, such factors as age and intelligence Group 2 will be homo geneous only in terms of the existence of a handicapping loss We expect such a project to take years to accomplish, but we feel that there is no other way to ferret out a possible answer to the problem We may find that no pattern exists and that there are no specific traits closely correlated with lip-reading ability, but to find even that is worth a try

In summary, it might be said that all of us who work with the hard-of-hearing have observed wide differences in lip-reading ability There are indications that such ability is not closely correlated with general intelligence or the amount of lip-reading instruction

A study has been outlined which will attempt to correlate such ability with specific psychological aptitudes and with projective tests of personality in order to arrive at some clues as to how to make lip-reading instruction more effective for those people who have difficulty learning the art

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SOME RHINOLOGICAL SYNDROMES AND VASOMOTOR RHINITIS *

JAMES CHESSEN, M D ,

and

IVAN W PHILPOTT, M D ,

Denver, Colo

Anatomical abnormalities of the nose are in themselves not necessarily causes of nasal disorders, however, when the anatomical malformation involves a part of the nose that is important to its physiological function, the disturbance created becomes a troublesome factor Cottle[1] has suggested that there are several such anatomical disharmonies which, at least in some cases, do cause the nasal disorder commonly referred to as vasomotor rhinitis

This discussion will concern itself with a brief description of several symptom complexes of nasal disorders which may well be called syndromes It is fitting to call them "Cottle's Nasal Syndromes" as he was the first to describe and correlate the clinical picture with disturbed anatomy in these instances

Oftentimes the etiology of vasomotor rhinitis rests in allergy, emotional disturbances, endocrine disorders, certain infectious conditions superimposed upon an allergic background, etc. For these cases we have little to add It is in those cases where the etiology is often obscure that consideration of these syndromes is suggested as etiological factors in vasomotor rhinitis This discussion will briefly concern five syndromes[2]

1 Open Space Syndrome.

2 Open Roof Syndrome

3 Upper Lateral Cartilage Syndromes

  a. Ballooning

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b Returning

c Insufficiency

4 Tension Nose Syndrome

5 High Clinical Nasal Index Syndrome

The nose can be divided into two parts the external and the internal[3] The external portion, the part extending from the face, is commonly called the external nasal pyramid It comprises the nasal bones, the upper lateral cartilages the lower or lateral or lobular cartilages, the vestibular structures, and part of the nasal septum This portion of the nose is, in reality, an attic or air cavity[3]

If one were to slice the external nose off the face, it would be at the nasal facial junction on a line drawn from the internal canthus region to the alar facial fold This would create the nasal aperture Posterior to this dividing plane is the internal nose where the nose turbinates and most of the functioning part of the nasal mucous membrane are located Physiologically, the mucous membrane can be divided into a lower respiratory portion and an upper olfactory portion

Cottle has demonstrated very convincingly that the external nose is designed not only to protect but also to prepare the incoming air for the internal nose

He says,[3] "The whole pyramid has several functions It plays a role in modifying and controlling the shape, course, pressure, velocities, and whirls of the air currents, it also serves, I believe, as a tempering chamber to modify the temperature of the inspired air before it enters the nasal chambers, also, it acts as a buffer to the air currents on expiration, holding back not only the air stream but also the moisture and warmth brought up from the lower respiratory tract To subserve these functions most efficiently, an insulated roof to the external nose is essential"

The syndromes described are chiefly concerned with the structures of the external nose In the main, malformation and malfunction of these structures permit air that is not properly prepared or conditioned to reach the internal nose This air then acts as an irritant to the nasal mucosa, which may result in congestion of the mucosa, altered secretions, neurological disturbances, and vascular alterations

Each of these syndromes has many individual characteristics, but all have at least one thing in common—vasomotor changes due to physical causes

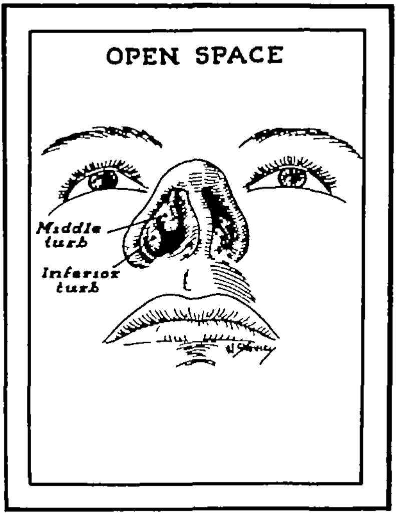

Fig 1 I. CLINICAL SYMPTOMS 1 Pain and headache PN drip 3 Cough and (bronchitis) 4 Sore and dry throat.

II DIFFERENTIAL DIAGNOSIS 1 Cephalgia—Histamine Sluder Costen, Psychoneurosis, 2 Allergy, 3 Endocrine disorders 4 Sinusitis 5 Psychoneurosis 6 Vasomotor rhinitis.

OPEN SPACE SYNDROME [1]

The disturbances created in the nose by excessive space alone have not been sufficiently recognized in the past On the contrary, surgical measures have been advocated which created more space in the nose The term "adequate space," or "adequate airway," was applied to describe the characteristics of the internal portion of the nose, basically meaning that there was plenty of room in the nose

Actually, excessive space in the nose is more of a hindrance than an aid to function Too much space prevents adequate resistance to the air currents It has been well established that nasal resistance is important in normal respiration It is thought that too much space in the nose also causes symptoms of vasomotor rhinitis (see Fig 1)

The symptoms frequently seen in Colorado and the Rocky Mountain region are epistaxis, crusting, dry irritated nose, vague ear symptoms, "winter bronchitis," raw sore throats, etc The number of patients having symptoms ascribed to the wide open side, the side referred to as having an adequate airway, is impressive

Of course, if such formidable anatomical anomalies as impaction of the septum and tension are present, symptoms will also be referred to the narrow side, and thus to both sides In this type of nose, excessive exposure and irritation of the anterior ends of the inferior and middle turbinates may produce a variety of symptoms which could well be confused with histamine cephalgia, Costen's syndrome, Sluder's syndrome, and infra or supraorbital neuralgia

OPEN ROOF SYNDROME [1]

The dorsum of the nose should act as a multilayered roof,[3] and every good roof provides insulation for the structures below Many patients have inadequate dorsums due to a variety of causes, namely, congenital abnormalities, nasal injuries, and diseases which have destroyed the cartilages The most common injuries, perhaps, are those produced by hump removal and fractures of the nasal bone (see Fig 2)

In nasal fractures it is important to remember that the bones, being membranous, heal by scar formation and not by bony union An inadequate roof may be the result

These patients present a clinical picture often labeled as physical allergy They cannot stand drafts, changes of weather, excess humidity, etc. Many are too often diagnosed as psychoneurotics, therefore, in examination of the nose, particular attention should be directed toward the nasal dorsum

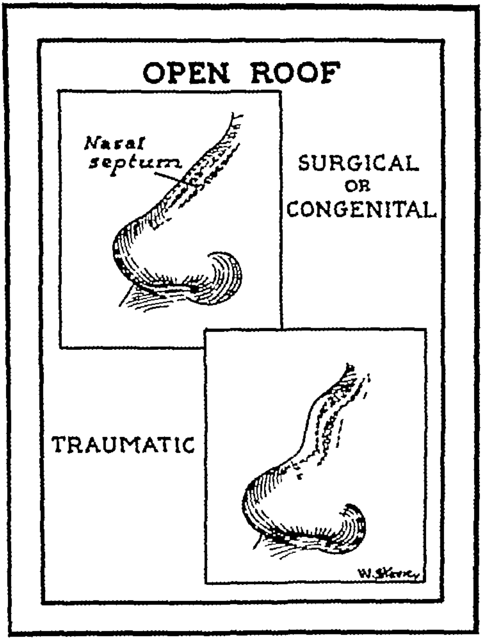

Fig 2. I. CLINICAL SYMPTOMS Can't stand changes of weather temperature, humidity wind, etc. Causes nasal irritation of all degrees.

II. DIFFERENTIAL DIAGNOSIS 1 Physical allergy 2 Psychosomatic disorders 3 Vasomotor rhinitis.

Palpation of the nasal dorsum will determine whether or not the nasal bones are present, whether or not the nasal bones are conjoined with the nasal septum and upper lateral cartilages, and whether or not the upper lateral cartilages are conjoined with the septum (see Fig 3)

Roentgenograms will frequently help in revealing the presence or absence of nasal bones In addition, a detailed history pertaining to injuries, surgery, and diseases which might have caused cartilage destruction or distortion will aid diagnosis

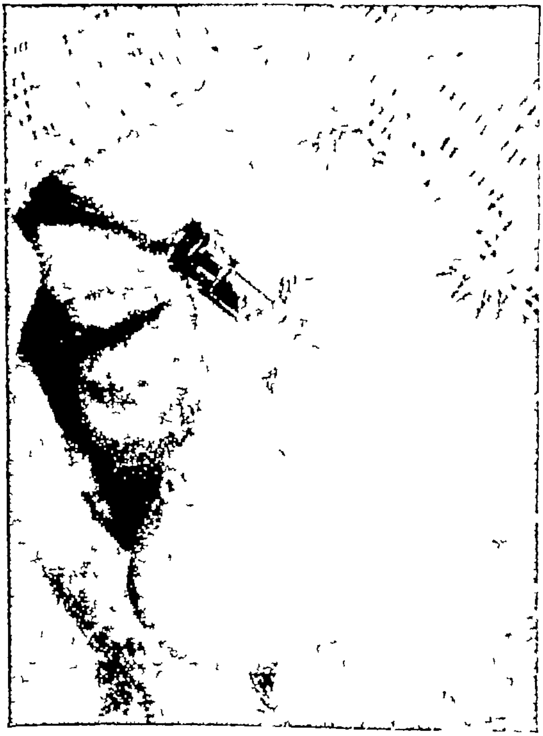

Fig 3 (Courtesy R H Riggs) Hypo needle through Open Roof reproducing patient's symptoms

Therapy consists of providing protection or reconstruction of the dorsum The nose should be covered for a trial period with flannel or similar covering, especially at night or when exposed to weather changes This will serve as both a diagnostic and a therapeutic aid

UPPER LATERAL CARTILAGE SYNDROME[1]

This syndrome is perhaps the most important The delicate mechanism of the integrated action of the upper lateral cartilage valve and lobular cartilage is very complex, and extremely important in the physiology of normal breathing The anatomy of the upper lateral cartilage must be understood thoroughly Actually, the upper lateral cartilages are wings of the septum They are attached superiorly, to a variable extent, to the under surface of the nasal bones by loose connective tissue At their caudal or terminal ends they join the septum by a fibrous union

At this fibrous junction there is a definite valve formation[4] that allows the upper lateral cartilage to swing closer to the septum on inspiration, and away from the septum on expiration This increases the pressure with which air is received and expelled through the nose.

Here, in a normal nose, there is only a slit like passage through which the air must pass The angle of the valve its stiffness, its relative position, and its mobility are all very important.

Time does not permit a detailed discussion, but it is suggested that the study of this mechanism will comprise a great deal of the rhinological activity of the near future,[6] both medical and surgical

The altered anatomy frequently found is

Ballooning or Bowing Out[2] Since this region of the nose is so frequently injured, numerous abnormalities may occur Normally, the upper lateral cartilage presents a convex surface to the nasal septum Injury may change the convexity of the presenting surface to a concavity which results in what Cottle refers to as a ballooning or bowing out of the upper lateral cartilage (see Fig 4)

This results in faulty valve action It also creates too much space and, consequently, the air acts as an irritant on the mucous membrane of the anterior end of the inferior and middle turbinates and may produce vasomotor symptoms

Returning[2] (see Fig 5) The terminal portion of the upper lateral cartilage is often reflected and curled on itself, thus producing a double layer of cartilage This results in a stiffness of the valve and inhibits the mobility of this portion of the valve This condition is best observed by the use of an ear speculum or small forceps[2]

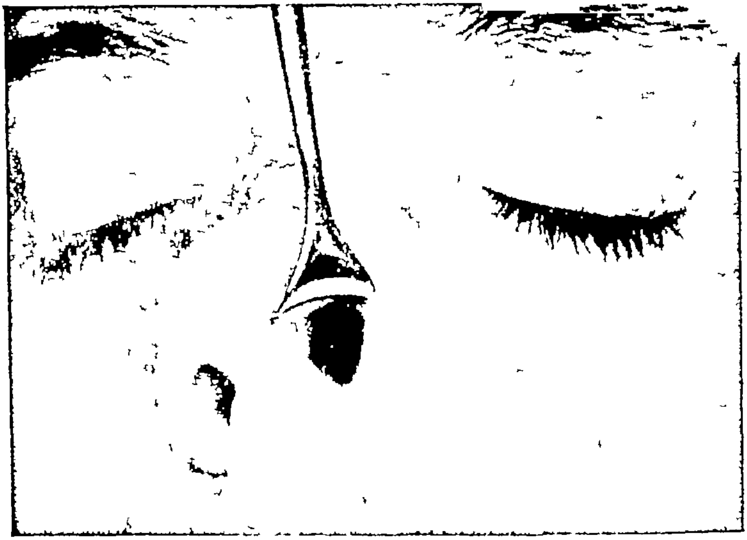

Fig 4 (Courtesy Dr R. Hadley) Ballooning upper lateral cartilage

Insufficiencies[2] Valve insufficiencies may result from numerous causes Among these are deformities of the upper lateral cartilages and the nasal septum, such as too much, too little, or even complete absence of cartilage These may result from previous trauma, hematomata, abscess formation and scarring Insufficiencies of the valve are far more frequent than previously suspected

TENSION NOSE SYNDROME[1]

Tension nose is a term which may describe conditions in which one or more anatomical parts of the nose have developed beyond their physiological limits It has been suggested that tension nose occurs in many ways, however, the most common is that of the high, long, frequently humped nose with a relatively straight septum so large that it seems to be trying to escape from the nose (see Fig 6) Such noses may cause varied symptoms, with headache being the predominant

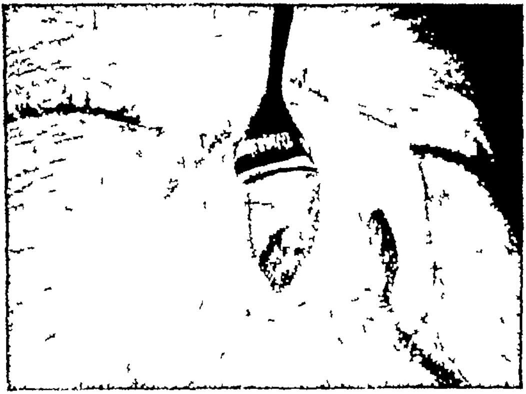

Fig 6 (Courtesy Dr R. Hadley) Returning upper lateral cartilage

complaint. Relief in these cases may be obtained by shortening and lowering the septum with preservation of the entire mucous membrane.

Another type of tension occurs with impactions[3] of the nasal septum in which circumscribed areas of mucous membrane are stretched to cover a shelfing or an obstruction Impaction also causes the bone or cartilage of the septum to be pushed into the structures of the lateral wall of the nose, where it may produce many reflex nerve disturbances Keeping in mind that ramifications of the Ist, Vth VIIth, IXth and Xth Cranial Nerves are in the nasal mucosa, it is not difficult to understand that many abnormal neurological reflex disturbances may occur

HIGH CLINICAL NASAL INDEX SYNDROME.[3]

Cottle, the first to call attention to the clinical significance of the nasal index, stressed the importance of determining whether the nasal index is within the normal limits for the ethnic group to which the patient belongs (see Fig 7) The measurements of the index are made on the patient's face (see Figs 8, 9)

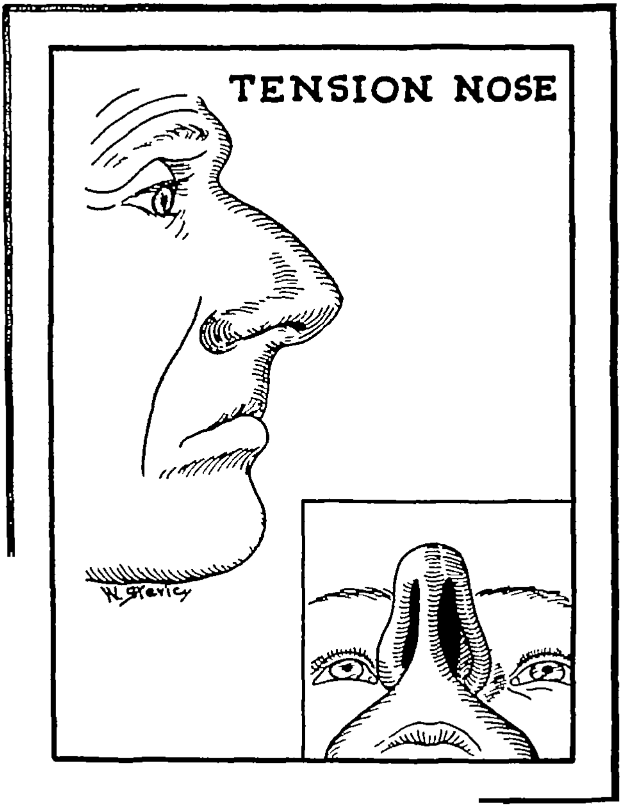

Fig 6 I CLINICAL SYMPTOMS 1 Headache 2 Head pain 3 Nasal obstruction 4 Excessive dryness or excessive drainage

II DIFFERENTIAL DIAGNOSIS 1 Cephalgia of all types 2 Vasomotor rhinitis 3 Allergy 4 Psychosomatic disorders

The width measured is the distance between the lateral crests of the pyriform aperture felt through the skin The height is the distance from the subnasale to the nasion, the latter being assumed to be at the level of the supra palpebral folds The index is obtained by dividing the width by the height and multiplying by 100 This is called the clinical nasal index

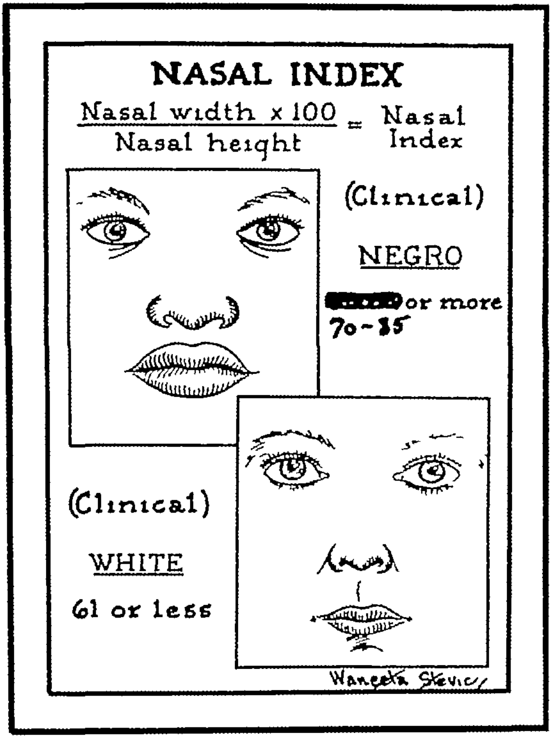

Fig 7 If Nasal Index is wrong for person he may be considered a "nasal cripple" in varying degrees

The following figures are what Cottle has found to be the normal clinical nasal index for the various races of mankind

Leptorrhine which includes the Caucasian Race, 61 or less.

Mesorrhine, which includes the American Indians and the Orientals, 62 to 69

Platyrrhine, which includes the Negro Race, 70 to 85

When these indices do not prevail in their appropriate ethnic groups, severe nasal disharmonies are the rule This is rather a drastic statement, but clinical observations in many patients this past year bear this out Much work has been done by others in measuring and correlating nasal index with ethnic origin

Fig 8 Nasal Index measuring width—lateral crests pyriform aperture

Williams,[6] in a paper soon to be published, has reviewed and carefully described all this work from an anthropological and clinical aspect and has added his own substantiations

Most of these syndromes have many common factors they often produce irritation of the mucous membrane which may cause altered secretion and reflex nerve disturbances Several are frequently found in the same patient. It is imperative not only to recognize these problems but also to have several simple therapeutic tests available

Fig 9 Nasal Index measuring height—subnasale to nasion.

Often these simple tests will help to evaluate a nose properly and perhaps to aid in determining whether or not surgical procedures are necessary to reconstruct the nose for proper physiological function If a wide open space syndrome is suspected as the cause of the symptoms, the patient should wear cotton in each nostril day and night for 48 to 72 hours

The cotton is placed in such a manner that it allows the patient to breathe through the nose. It is believed that the effect of the cotton is merely to slow, still and filter the air[3]

Relief of headache and improvement of symptoms will frequently be dramatic

If an open roof is suspected, especially with a history of old injury, previous rhinoplasty, or physical allergy, the patient should try wearing a cover over the nose,[2] particularly at night and during weather changes This often proves beneficial to the patient, and indicates that surgical repair of the nasal dorsum may give relief

One may learn a great deal from listening to his patients When one of them says, and very frequently shows, that by tilting up his nose or by pulling on his cheek "to open up his nose," he can breathe better, he has pointed out his difficulty What the patient has demonstrated is that the lobule and upper lateral cartilages of his nose are at fault, that the valve action of the upper lateral cartilage is impaired and must be reviewed, revised, and reconstructed These patients should not be dismissed as neurotics

To examine the upper lateral cartilages and the valve mechanism it is essential to clip the vibrissae and observe the movements of the terminal ends of the upper lateral cartilages with the patient's head in various positions,[1] and without the use of instruments in the nose (see Figs 17-18) Only then can one diagnose, with any degree of accuracy, a ballooning, a returning and other degrees of insufficiency of the valve mechanism

The history of the patient's sleeping habits must be carefully evaluated[2] If he cannot sleep on the right side, for example, one must check the upper lateral cartilage and vestibular elements on the opposite side with extreme care Thus, the patient's history is again very important The examination of the base of the nose and the vestibular structures without the use of instruments is indispensable

Measurement of the clinical nasal index, a simple procedure
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as the audiometer is to the otologist

As aids in evaluating nasal health, the following are suggested

Try placing cotton in the wide side or open space syndrome

Try protecting the open roof with flannel or other covering

Try correlating the nasal index measurements with nasal symptoms

Try examining the vestibular structures without the use of instruments.

Try examining the valve action in various head positions

Try correlating sleeping habits with disturbed valve action

And finally, try thinking about the nose as an important organ of breathing, and not just in terms of inflammation, infection and allergy

SUMMARY

Vasomotor rhinitis has been discussed, and some important rhinological syndromes suggested as etiological factors Simple diagnostic and therapeutic tests have been stressed as important routine procedures for the rhinologist in his every day practice. In a sense, it is thought that you have been introduced to the whole family of "Cottle's Nasal Syndromes," realizing that there has not been enough time to make you well acquainted with any one of the individual members It is hoped that you will find time and opportunity to do so in the future

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Measurement of the clinical nasal index, a simple procedure taking but a few moments, will give valuable information It is believed that the measurement and evaluation of the nasal index will not only be a routine procedure for the rhinologist in the future but will also become as important to him for diagnostic purposes, as the audiometer is to the otologist

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1. Cottle, M H Seminar Notes, Introduction to Fundamentals of Reconstructive Surgery of Nasal Septum and External Nasal Pyramid *Ill Masonic Hosp.*, 1947

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3. Cottle, M H Nasal Roof Repair and Hump Removal. *Jour A.M.A Arch Otolaryngol* 60 408-414 Oct. 1954

4. Mink, P J Das Spiel der Nasenflügel. *Arch f d. ges Physiol.*, Vol. 120 210-224 1907

5. Williams R. I Personal Communication.

6. Cottle, M H The Role of the Rhinologist in Rhinoplasty The Laryngoscope, Vol. LXIII 608-618, July 1953

SEVENTY-SIXTH ANNUAL MEETING OF THE AMERICAN LARYNGOLOGICAL ASSOCIATION

at Hollywood Beach Hotel, Hollywood, Fla

March 13 - 14, 1955

PROGRAM

March 13, 1955

The Indications and Technique of Lymph Node Dissection of the Neck............Alton Ochsner, M D

Evaluation of Neck Dissection in Carcinoma of the Larynx
Louis H Clerf, M D

Mixed Tumors of the Posterior Pharyngeal Wall............Fred Z Havens, M D , and L C Butler, Jr , M D (by invitation)

Vasomotor Rhinitis............Theodore E Walsh, M D

A Few Highlights Concerning Respiratory Cilia.....G Edward Tremble, M D

The Radical Obliterative Frontal Sinus Operation A Consideration of Technical Factors in Difficult Cases............Robert L Goodale, M D

Rehabilitation of Patients with Clefts of the Lip and Palate (Motion Picture Presentation)............Dean M Lierle, M D

March 14, 1955

Unilateral Cord Paralysis............Daniel S Cunning, M D

Ten-Year Progress of Laryngofissure Operation............Mercer G Lynch, M D

General Tonsillectomy Suggestions for Management and Peritonsillar Injection............Paul M Moore, M D

Carcinoma of Maxillary Sinus in Youth............Bernard J McMahon, M D

Functional Disturbances of the Upper Swallowing Mechanism
John R Lindsay, M D

The Globus Syndrome as Related to Demonstrable Pathology of the Cervical Spine............Lewis F Morrison, M D

The Clinical Significance of a Motor Pattern in the Nucleus Ambiguous............A C Furstenberg, M D

Blastomycosis of the Larynx............William C Thornell, M D

Laryngeal Papillomata Surgical Technique for Removal of Recurring and Obstructive Growths............DeGraaf Woodman, M D

FIFTY-NINTH ANNUAL MEETING OF THE AMERICAN LARYNGOLOGICAL, RHINOLOGICAL, AND OTOLOGICAL SOCIETY

at Hollywood Fla

PROGRAM

Tuesday, March 15 1955

Time

A M

Scientific Session

9 50 *1 Lateral Vestigial Cysts and Fistulas of the Neck*
Bruce Proctor, M D , Detroit, Mich , (Candidate's Thesis)

10 10 Open Discussion

10 20 *2 Stress and Disease*
Professor Hans Selye, Director of the University of Montreal Institute of Experimental Medicine and Surgery (By invitation)

11 20 Open Discussion

11 40 *15-Minute Recess*

11 55 *3 Otoscopic Cinematography of the Tympanic Membrane and Middle Ear*
Paul H Holinger M D , Chicago Ill
(Co-authors Kenneth C Johnson, M.D , Richard Buckingham, M D , Francis E Lederer, M D , and Marvin Tamari, M D)

P M

12 25 *4 Epistaxis—Evaluation of Surgical Care*
Bernard L Silverblatt, M D Pittsburgh, Pa. (Candidate's Thesis)

12 45 Open Discussion

Wednesday, March 16, 1955

A.M

Scientific Session

9 30 *5 Surgical Treatment of Cancer of the Paranasal Sinuses*

Time
A M

Edgar L Frazell, M D, New York, N Y (B
invitation)

10 00 6 *X-ray Therapy of Inoperable Cancer of Head a*
Neck
Frank D Lathrop, M D, Boston, Mass
Magnus I Smedal, M D, Boston, Mass (B
invitation)

10 30 Combined Discussion and Question Period

10 50 7 *Recent Observations on Living Human Cells with*
Cinematographic Technique
C M Pomerat, M D, Professor of Cytology, The
University of Texas, Medical Branch (By invit
tion)
No Discussion

11 50 *15-Minute Recess*

P M
12 05 8 *Laryngectomy and Neck Dissections—Colored*
Movie
Julius W McCall, M D, Cleveland, Ohio

12 25 9 *The Development of the Epithelium of the Larynx*
Eugene S Hopp, M D, San Francisco, Calif
(Candidate's Thesis)

12 45 Open Discussion

Thursday, March 17, 1955

A M

Scientific Session

9 30 10 *Presbycusis*
Harold F Schuknecht, M D, Detroit, Mich
(Candidate's Thesis)

9 50 Open Discussion

10 00 11 *Cancer of the External Auditory Meatus*
Daniel Miller, M D, Boston, Mass

10 20 Open Discussion

10 30 12 *Trans-Sphenoidal Approach to the Pituitary*
Albert C Furstenberg, M D, Ann Arbor, Mich

Time
A.M
11 00 Open Discussion
11 10 *15-Minute Recess*
11 25 *13* *Unusual Endoscopic Lesions—Motion Picture*
Paul H Holinger, M.D , Chicago, Ill
11 45 *14* *Restoration of Hearing in Otosclerosis by Mobilization of the Fixed Stapedial Footplate an Analysis of Results*
Samuel Rosen, M D , New York, N Y
P.M
12 15 Open Discussion

PROGRAM OF EIGHTY EIGHTH ANNUAL MEETING OF THE AMERICAN OTOLOGICAL SOCIETY, MARCH 17, 18, 19, 1955

Hollywood Beach Hotel Hollywood, Florida.

Thursday Afternoon, March 17, 1955

Registration 1 30 P M.

INTRODUCTION OF GUESTS

SCIENTIFIC MEETING 2 00 P M

1 *Address of President*______D E Staunton Wishart, M D
2 *Introduction of the Guest of Honor*__Harold Walker, M D
3 *The Fetal and Early Postnatal Development of the Tympanic Ring and Related Structures in Man*_______Barry J Anson, Ph D , Theodore Bast, Ph.D , and Shafik R Richany, M S (by invitation)
4 *Bilateral Congenital Atresia of the External Auditory Meatuses*____________________Franz Altmann M D
5 *Auditory Fatigue and Adaptation in the Differential Diagnosis of End-Organ Deafness*__________J D Hood, Ph.D (by invitation)
6 *An Additional Five-Year Review of Some Cases of Vertigo Reported in 1949*____________William J McNally, M.D , and Edwin A. Stuart, M D

Time
A M

Edgar L Frazell, M D , New York, N Y (By invitation)

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10 30 Combined Discussion and Question Period

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Friday Morning, March 18, 1955—9 00 A M

1 *Comparative Bone Conduction Excitation of Cochlear Microphonics in Tympanic and Labyrinthine Lesions*....Victor Goodhill, M D

2 *Elastic Tissue of the Eustachian Tube*.... ....Stacy R Guild, Ph.D

SYMPOSIUM ON BLOOD CIRCULATION

1 *Vascular Phenomena of Living Tissues As Observed Microscopically*.... Eliot R Clark, M D (by invitation)

2 *Small Blood Vessels During Allergic Reactions*....John W Irwin, M D (by invitation)

3 *Circulation of the Blood in the Living Cochlea. Microscopic Observations* ....Henry B Perlman, M D, and Robert S Kimura (by invitation)

4 *The Effect of Anoxia on Cochlear Potentials*.... ....Cesar Fernandez, M D (by invitation)

5 *Observations on the Clinical Side of the Problem*....Albert C Furstenberg, M D

6 *Summary of the Symposium and Comments*.... .Hallowell Davis, M D

Saturday Morning, March 19, 1955—9 00 A M

1 *Chemodectoma, Especially with Reference to Sensitivity to X-Ray*.... ....Henry L Williams, M D, D S Childs, Jr, M D (by invitation), Edith M Parkhill, M D (by invitation), and D G Pugh, M D (by invitation)

2 *Problems Related to the Use of Speech in Clinical Audiometry*.... ....S Richard Silverman, Ph D, and Ira J Hirsh, Ph D (by invitation)

3 *Late Results of Facial Nerve Repair*.... ....Robert C Martin, M D

4 *A Review of Some Recent Studies Concerned with the External Ear*.... ....Ben H Senturia, M D, Lawrence H Sophian, M D (by invitation), Oliver H Lowry, M D (by invitation), and Sing-Pao Chiang, Ph D (by invitation)

5 *Induction of Incoming President*

UNIVERSITY OF ILLINOIS ANNUAL ASSEMBLY IN OTOLARYNGOLOGY

The Department of Otolaryngology, University of Illinois College of Medicine, announces its Annual Assembly of Otolaryngology from September 19 through October 1, 1955 This Assembly will consist of two parts

Part I — September 19 through September 24, 1955, will be devoted to surgical anatomy of the head and neck, fundamental principles of neck surgery and histopathology of the ear, nose and throat. This week will be under the personal direction of Maurice F Snitman, M D

Part II — September 26 through October 1, 1955, will be devoted entirely to lectures and panel discussion of advancements in otolaryngology The chairman of this section will be Emaneul M Skolnik, M.D

Registration is optional for one or both weeks For further information, address Dr Francis L Lederer, 1853 West Polk St., Chicago 13, Ill

BRONCHOESOPHAGOLOGY COURSE

The next Bronchoesophagology Course to be given by the Temple University School of Medicine is scheduled for June 13 to 24, 1955, under the direction of Dr Chevalier L Jackson

Interested registrants will please write directly to the Department of Laryngology and Bronchoesophagology, Temple University School of Medicine, 3400 North Broad Street, Philadelphia 40, Pa.

POSTGRADUATE COURSE IN OTOLARYNGOLOGY

The Department of Postgraduate Medicine of the University of Michigan Medical School announces the Otolaryngology Conference to be given at the University Hospital, Ann Arbor, Michigan, April 14, 15 and 16, 1955, under the direction of Dr A. C Furstenberg, Chairman of the Department of Otolaryngology at the University of Michigan Medical School

Guest Lecturers Dr John M Converse, New York City, N Y , Dr Julius Lempert, New York City, N Y , Dr Alden

H Miller, Los Angeles, Calif , Dr Werner Mueller, Boston, Massachusetts, Dr Henry L Williams, Rochester, Minnesota.

Resident Lecturers Dr A C Furstenberg, Dr James H Maxwell, Dr Walter J Nungester, Dr James L Wilson, Dr J F Holt, Dr Isadore Lampe

For further information, address Dr John M Sheldon, Director, Department of Postgraduate Medicine, University Hospital, Ann Arbor, Michigan

KENFIELD SCHOLARSHIP

The American Hearing Society announces March 1 as opening date for competition for the 1955 Kenfield Memorial Scholarship, an award made annually to a prospective teacher of lipreading Application blanks may be obtained by writing to the society's national headquarters, 817 14th St , N W Washington 5, D C

Deadline for returning completed applications is May 1 They are to be mailed to Mrs Dorothy J Cornett, 4310 S W 14th St , Coral Gables 34, Fla

Winner of the Kenfield Memorial award is entitled to take a teacher training course in lipreading from any school or university in the United States acceptable to the Teachers Committee The scholarship is to be used within one year from the date of award

MEETING OF THE GEORGIA SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

The Georgia Society of Ophthalmology and Otolaryngology will meet March 11 - 12, 1955, at the General Oglethorpe Hotel, Savannah, Georgia.

The speakers will be Dr Francis H Adler, Philadelphia, J W McCall, Cleveland, Dr J A Hilger, St Paul, Dr Walter H Fink, Minneapolis, Dr James H Allen, New Orleans, and Dr P E Ireland, Toronto, Canada For further details, address Alton V Hallum, M D , Secretary, 245 Doctors Bldg , Atlanta 3, Ga

DIRECTORY OF OTOLARYNGOLOGIC SOCIETIES

(Secretaries of the various societies are requested to keep this information up to date)

AMERICAN OTOLOGICAL SOCIETY

President Dr D E Staunton Wishart 170 St. George St., Toronto 5 Ontario Canada.
Vice-President Dr Wm J McNally 1509 Sherbrooke St. West Montreal 25 Canada.
Secretary Treasurer Dr John R. Lindsay 950 E 59th St. Chicago 37 Illinois
Editor Librarian Dr Henry L. Williams Mayo Clinic Rochester Minn
Meeting Hollywood Hotel, Hollywood Fla. March 17 (afternoon) 18 (forenoon and afternoon) 19 (forenoon) 1955

AMERICAN LARYNGOLOGICAL ASSOCIATION

President Dr Henry B Orton Newark N. J
First Vice-President Dr Jas H Maxwell Ann Arbor Mich.
Second Vice-President Dr Clyde A. Heatley Rochester N Y
Secretary Harry P Schenck, Philadelphia Pa.
Treasurer Fred W Dixon Cleveland Ohio
Librarian Historian Dr Bernard J McMahon, St. Louis Mo
Meeting Hollywood Hotel Hollywood Fla March 13 14 1955

AMERICAN LARYNGOLOGICAL, RHINOLOGICAL AND OTOLOGICAL SOCIETY, INC.

President Dr Kenneth M. Day 121 University Pl., Pittsburgh, Pa.
President Elect. Dr Dean M Lierle Iowa City Iowa.
Secretary Dr C Stewart Nash, 277 Alexander St. Rochester N Y
Eastern Section Meeting Friday January 7 1955 Philadelphia Pa., Hotel Warwick
Triological Council Meeting Saturday January 8 1955 New York City The Waldorf Astoria.
Western Section Meeting Saturday Sunday January 15 16 1955 Los Angeles Cal. The Town House.
Southern Section Meeting Saturday January 22 1955 Charlottesville Va. Medical School Auditorium.
Middle Section Meeting Monday January 24 1955 Detroit, Mich Sheraton-Cadillac Hotel
Meeting Hollywood Hotel, Hollywood, Fla. March 15-16 17 1955 morning only

AMERICAN MEDICAL ASSOCIATION
SECTION ON LARYNGOLOGY OTOLOGY AND RHINOLOGY

Chairman Dr F W Davison Danville Pa.
Vice-Chairman Dr Guy L. Boyden Portland Ore.
Secretary Dr Hugh A. Kuhn Hammond Ind

AMERICAN ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President Dr Algernon B Reese 73 East 71st St. New York 21 N Y
Executive Secretary Dr William L. Benedict, Mayo Clinic Rochester Minn
Meeting Palmer House Chicago Ill., October 9 15 1955

AMERICAN BOARD OF OTOLARYNGOLOGY

Meeting Hotel Marshall Richmond Va., March 6-10 1955
Palmer House Chicago Ill., October 1955

AMERICAN BRONCHO ESOPHAGOLOGICAL ASSOCIATION

President Dr Clyde A. Heatley, 11 No Goodman St., Rochester, N Y
Secretary Dr F Johnson Putney, 1719 Rittenhouse Square, Philadelphia, Pa
Meeting Hollywood Beach Hotel, Hollywood, Fla., March 15-16, 1955, afternoon only

PUGET SOUND ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President Dr Clifton E Benson Bremerton, Wash
President Elect Dr Carl D F Jensen, Seattle, Wash
Secretary Dr Willard F Goff, 1215 Fourth Ave , Seattle, Wash

THE SECTION OF OTOLARYNGOLOGY OF THE MEDICAL SOCIETY OF THE DISTRICT OF COLUMBIA

Chairman Dr John Louzan
Vice Chairman Dr Willard B Walters
Secretary Dr Jack L Levine
Treasurer Dr Russell S Page, Jr
Meetings are held on the third Tuesday of October, November March and May, 7 00 P M
Place Army and Navy Club Washington D C

GEORGIA SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

Meeting General Oglethorpe Hotel, Savannah, Ga., March 11 12, 1955

THE GREATER MIAMI EYE, EAR, NOSE AND THROAT SOCIETY

President Dr Ralph Kirsch, 1345 N Bayshore Drive, Miami Fla
Vice-President Dr Garland Johnson, Blount Bldg , Fort Lauderdale Fla.
Secretary Dr James H Mendel, Jr , 7241 Red Road, Miami, Fla.
Meeting Quarterly, at Seven Seas Restaurant, February, May, October, and December

CHICAGO LARYNGOLOGICAL AND OTOLOGICAL SOCIETY

President Dr Norman Leshin, 55 East Washington St., Chicago, Ill
Vice-President Dr Henry B Perlman, 950 East 59th St., Chicago, Ill
Secretary-Treasurer Dr Stanton A. Friedberg 122 So Michigan Ave., Chicago, Ill
Meeting First Monday of each Month, October through May

THE LOUISIANA MISSISSIPPI OPHTHALMOLOGICAL AND OTOLARYNGOLOGICAL SOCIETY

President Dr W L Hughes, Lamar Life Bldg , Jackson, Miss
Vice-President Dr Ralph H Riggs, 1513 Line Ave , Shreveport, La.
Secretary Dr Edley H Jones, 1301 Washington St., Vicksburg, Miss

OTOSCLEROSIS STUDY GROUP

President Dr Gordon D Hoople, 1100 East Genesee St , Syracuse, N Y
Secretary Dr Lawrence R Boies, Med Arts Bldg , Minneapolis 2 Minn
Meeting Palmer House, Chicago, Ill , Oct. 9, 1955

AMERICAN SOCIETY OF OPHTHALMOLOGIC AND OTOLARYNGOLOGIC ALLERGY

President Dr F Lambert McGannon, 14595 Madison Ave , Lakewood 9, Ohio
Secretary Treasurer Dr Michael H Barone, 468 Delaware Ave , Buffalo 2, N Y
Meeting Palmer House, Chicago Ill., October 1955

PAN AMERICAN ASSOCIATION OF OTO-RHINO-LARYNGOLOGY AND BRONCHO-ESOPHAGOLOGY

President Dr J M. Tato, Azcuenaga 235 Buenos Aires Argentina
Executive Secretary Dr Chevalier L. Jackson 1901 Walnut St. Philadelphia 3 Pa., U S A
Meeting: Fifth Pan American Congress of Oto-Rhino-Laryngology and Broncho-Esophagology
President Dr J H. Font, Medical Arts Bldg., San Juan P R.
Time and Place 1956, Puerto Rico

MISSISSIPPI VALLEY MEDICAL SOCIETY

President Dr Arthur S Bristow Princeton Mo.
Secretary Treasurer Dr Harold Swanberg Quincy Ill
Assistant Secretary Treasurer Dr Jacob E. Reisch Springfield, Ill.
Meeting

THE VIRGINIA SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President Dr G S Fitz Hugh, Charlottesville Va.
President Elect Dr H. L. Mitchell Lexington Va.
Vice-President Dr Marion K. Humphries Charlottesville Va
Secretary Treasurer Dr L. B Sheppard 301 Medical Arts Bldg., Richmond Va.

Spring Meeting Natural Bridge Hotel, Natural Bridge, Va., May 7-8, 1955

LOS ANGELES SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President Harold Owens M.D
Secretary Treasurer Robert A. Norene, M D

Chairman of Section on Ophthalmology Sol Rome M.D.
Secretary of Section on Ophthalmology Wendell C Irvine, M.D

Chairman of Section on Otolaryngology Max E. Pohlman M.D
Secretary of Section on Otolaryngology Herschel H Burston M.D.

Place Los Angeles County Medical Association Building 1925 Wilshire Boulevard, Los Angeles 57 Calif.
Time 6 00 P.M., first Thursday of each month from September to June inclusive—Ophthalmology Section. 6 00 P M fourth Monday of each month from September to June inclusive—Otolaryngology Section

AMERICAN OTORHINOLOGIC SOCIETY FOR THE ADVANCEMENT OF PLASTIC AND RECONSTRUCTIVE SURGERY

President Dr Harry Nievert, 555 Park Ave., New York (21) N Y
Secretary Dr Louis Joel Feit, 66 Park Ave., New York (16) N Y
Meeting

NORTH CAROLINA EYE EAR NOSE AND THROAT SOCIETY

President Dr Cecil Swann Asheville N C.
Secretary and Treasurer Dr Geo B Ferguson, Durham N Car
Meeting Jointly with the South Carolina Society of Ophthalmology and Otolaryngology Columbia, So Car Sept. 12-14, 1955

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THE
LARYNGOSCOPE.

VOL. LXV MARCH, 1955 No 3

CLINICAL APPLICATIONS OF RECRUITMENT AND MASKING*

FREDERICK HARBERT, M D,
and
JOSEPH A. SATALOFF, M D,
Philadelphia, Pa.

CLINICAL APPLICATION OF RECRUITMENT

The purpose of this presentation is to invite attention to the diagnostic and prognostic values of recruitment studies, and to advocate their routine use in cases of perceptive deafness Recruitment of loudness occurs predominantly in pathologic ears, and is an abnormally large growth in the sensation of loudness as compared to the increase in the physical intensity of the signal Since loudness is a psychological phenomenon, it requires a subjective judgment from the patient. There is, as yet, no truly objective method of measuring recruitment.

The patient whose ear recruits generally presents some of the following symptoms

1 Distortion is probably present if the patient complains of voices or music sounding tinny, hollow, or fuzzy

2 Diplacusis is present if a tuning fork has a different pitch in the recruiting than in the nonrecruiting ear The pitch usually sounds higher in the recruiting ear The frequency of the fork should be one in which a well marked hearing defect is present.

Read at the meeting of the Eastern Section American Laryngological Rhinological and Otological Society Inc., Philadelphia, Pa., January 7, 1955.

Editor's Note This ms. received in The Laryngoscope Office and accepted for publication, February 23, 1955

3 A lowered threshold of discomfort is implied if loud noises, ordinarily well tolerated by the normal ear, produce discomfort A loud tuning fork, for example, will cause the patient to wince or sharply withdraw his head This will not occur in the nonrecruiting ear

4 The patient with recruitment usually has much sharper, more definite, audiometric end points than found in conductive losses

5 Variable hearing occurs specifically in labyrinthosis, and is unlike the subjective daily variations found in conductive and functional hearing losses In labyrinthosis there may be poor hearing for days, weeks, or months followed by improvement These changes can occur intermittently and are demonstrable on the audiogram

For clinical purposes the alternate loudness balance test, first described by Fowler, is a practical method to determine recruitment This test requires at least a 20 db difference in threshold between the two ears in the frequency being tested, that is, if one ear is normal or the pathology is the same in both ears If the pathology differs in each ear, recruitment of loudness may still be apparent, even though the thresholds are the same as demonstrated by Dr Harbert (see Fig 4)

The monaural loudness balance test can also be used in clinical practice, but should be interpreted with full appreciation of the difficulties in comparing the loudness of two tones of different pitches This difficulty is even apparent in the alternate loudness balance test when diplacusis is present, for patients will often complain of uncertainty in loudness comparison, because the pitch sounds differently in either ear

Difference limen testing, that is, determining the intensity difference between two sounds which is just perceptible as a change in loudness, gives promise of being a useful technique for determining recruitment, but it is still in the investigative stage In our hands the Luscher Test, as available on a commercial instrument, has not added to our clinical information

The manner in which any of these tests is performed is of utmost importance for a valid interpretation Hood, for example, has shown that when a recruiting ear is exposed to a continuous stimulus, such as used in a Bekesy type audiometer, a pathologic adaptation occurs and may cause recruitment to disappear completely. Consequently, it is essential to use only short bursts of tone when performing loudness balance testing.

According to the most widely accepted concepts, a recruiting ear indicates a lesion in the organ of Corti. Recruitment is not present in a lesion restricted to the neural pathway. Where pathology exists in both the organ of Corti and neural pathway, it is felt that recruitment will probably be present if the proportion of hair cell damage is greater than nerve fiber involvement. If this proportion is reversed, however, then recruitment may not be present. Consequently, the presence of recruitment suggests pathology in the organ of Corti, but its absence does not preclude such pathology.

Table I.

RECRUITING		NON RECRUITING
Ménière's	(Most)	Conductive Losses
Labyrinthosis	(Post Fenest.)	*Presbycusis (Many)*
Stimulation Deafness	(Temporary)	Acoustic Neuroma
Acoustic Trauma	(Some)	Psychogenic Deafness

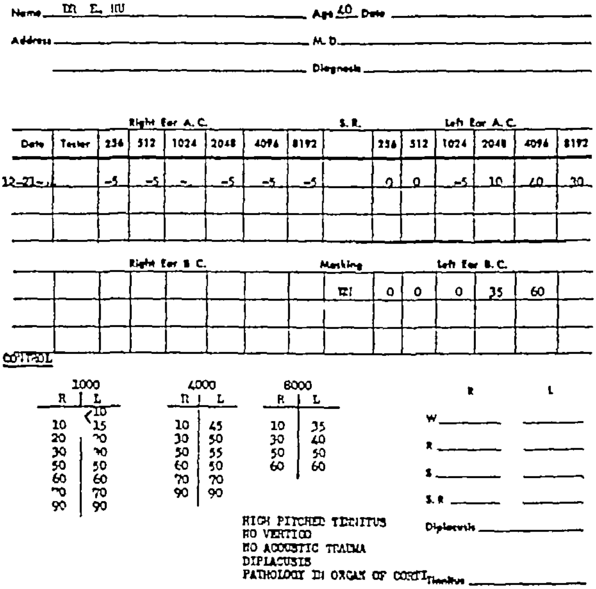
Despite the lack of rigid pathological and experimental confirmation these concepts seem to explain best the many clinical entities and to emphasize the need for further investigation.

Recruitment is not present in conductive losses, acoustic neuromas, and psychogenic hearing losses. It is generally not present in presbycusis, except in certain types where the organ of Corti is primarily involved. Recruitment is characteristically present in Meniere's syndrome and post fenestration labyrinthosis, that is, until the hearing markedly improves or the pathology sufficiently extends into the neural pathways.

The use of recruitment studies to distinguish permanent acoustic trauma from presbycusis and other high tone losses has received much attention but is presently quite difficult, because recruitment may be present in only certain stages of acoustic trauma and because many ears showing audiograms similar to those seen in acoustic trauma give no history of exposure to intense noise

Fig 1 and others are often diagnosed as acoustic trauma despite the absence of any exposure to intense noise and even though they are found in female patients Are we justified

Fig 1



Name DR E. WU Age 40 Date
Address M. D.
Diagnosis

		Right Ear A. C.						S. R.	Left Ear A. C.					
Date	Tester	256	512	1024	2048	4096	8192		256	512	1024	2048	4096	8192
12-21-..		-5	-5	-	-5	-5	-5		0	0	-5	10	40	30

		Right Ear B. C.						Masking	Left Ear B. C.					
								WI	0	0	0	35	60	

CONTROL

1000 R	1000 L
10	<10 15
20	20
30	30
50	50
60	60
70	70
90	90

4000 R	4000 L
10	45
30	50
50	55
60	50
70	70
90	90

8000 R	8000 L
10	35
30	40
50	50
60	60

	R	L
W		
R		
S		
S. R		

Diplacusis
Tinnitus

HIGH PITCHED TINNITUS
NO VERTIGO
NO ACOUSTIC TRAUMA
DIPLACUSIS
PATHOLOGY IN ORGAN OF CORTI

in labeling these ears hypersensitive to noise? Or is this hereditary nerve deafness, a type of labyrinthosis, or some other condition?

The next few slides show the usefulness of recruitment studies in establishing the major site of pathology

Fig 2 shows vertigo, etc, and the absence of recruitment indicates pathology in neural pathway

Fig 3 presents classical Meniere's with recruitment indicating pathology in organ of Corti

Fig 2

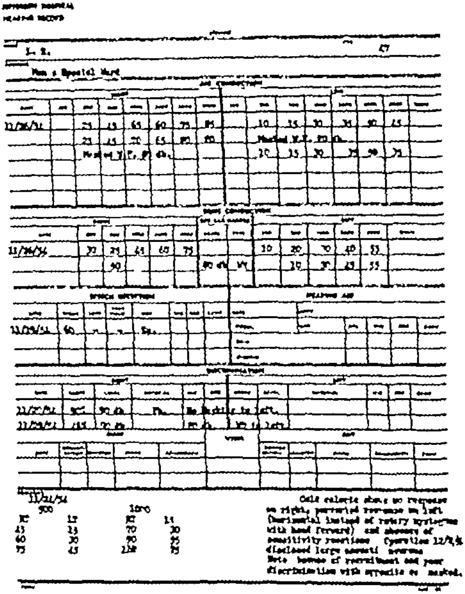
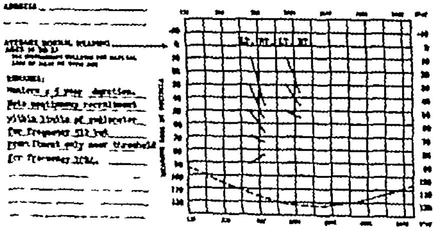


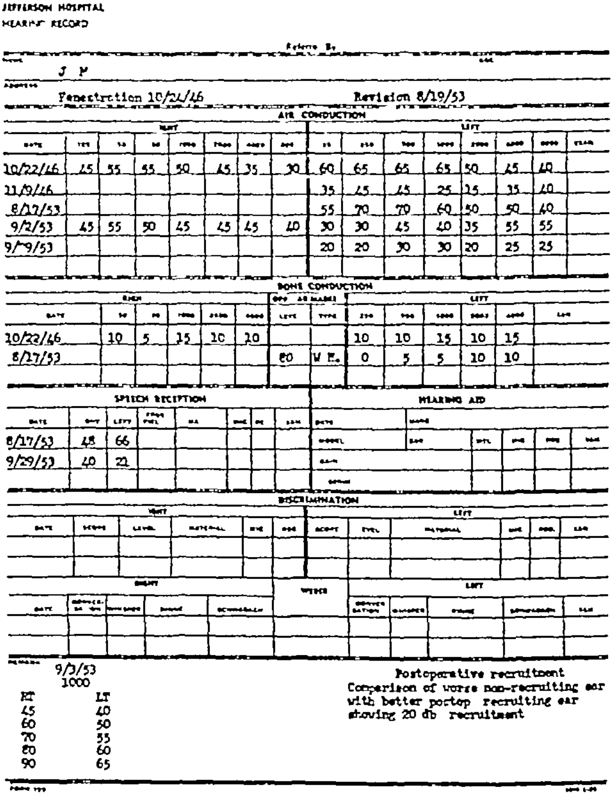
Fig 3



This last slide also helps confirm our impression that there is essentially only one type of recruitment which may vary in degree as measured by the alternate loudness balance test Different degrees may occur in the same individual

There is also a prognostic value to the presence of recruitment since it seems to be associated with hearing loss that is in a state of flux

Fig 4



JEFFERSON HOSPITAL
HEARING RECORD

Referred By

J P

Fenestration 10/21/46 Revision 8/19/53

AIR CONDUCTION

	RIGHT							LEFT							
10/22/46	45	55	55	50	45	35	30	60	65	65	65	50	45	40	
11/9/46								35	45	45	25	15	35	40	
8/17/53								55	70	70	60	50	50	40	
9/2/53	45	55	50	45	45	45	40	30	30	45	40	35	55	55	
9/~9/53								20	20	30	30	20	25	25	

BONE CONDUCTION

	RIGHT							LEFT					
10/22/46	10	5	15	10	10			10	10	15	10	15	
8/17/53						80	W N.	0	5	5	10	10	

SPEECH RECEPTION

HEARING AID

8/17/53	48	66					
9/29/53	40	21					

DISCRIMINATION

9/3/53
1000

RT	LT
45	40
60	50
70	55
80	60
90	65

Postoperative recruitment
Comparison of worse non-recruiting ear with better postop recruiting ear showing 20 db recruitment

For example, as Dr Harbert points out that in post fenestration labyrinthosis (see Fig 4), as long as recruitment is present there is still some possibility of hearing improving or getting worse, however, once recruitment disappears there is very little chance of improvement in hearing The disappearance of recruitment in Meniere's syndrome without improvement in hearing often suggests neural pathology and a less favorable prognosis These generalizations are, of course, not without exception, for they are necessarily based on limited clinical experience, but they serve as a frame of reference in which further studies and interpretation of recruitment may be evaluated

In conclusion, the fact that recruitment of loudness is characteristically present in some conditions but not others and that it can be established by tests simple enough to perform in an otologist's office warrants its routine use in patients with perceptive hearing loss, furthermore, its presence or absence in a patient whose clinical picture is otherwise inconclusive may help localize the predominant site of pathology in the ear

MASKING

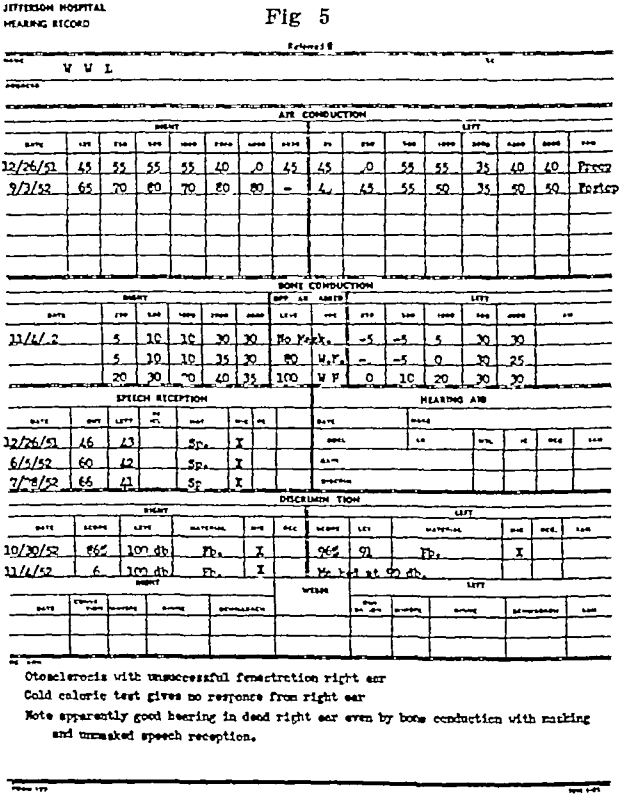
The ear is constantly bombarded by auditory stimuli and spontaneous aural discharges When a stimulus is not appreciated because of the simultaneous presence of another, one stimulus is said to mask the other The relation of ambient or masking noise to the stimulus is often compared to a field of grass (ambient noise) and a flower (stimulus) It is important to remember that the flower in this analogy need not protrude above the level of the grass It can be appreciated even when it is a certain distance below the surface For the important speech frequencies white noise masks at a level of about 30 db below its overall level In other words the flower is appreciated at a level 30 db below the surface of the noise level In the case of low tones (below 300) the level is 45-65 db below the overall level This is one reason for the difficulty of eliminating low tone hearing by masking

Clinical application of the above is that the ambient noise in a test room should not be above 30 db for free field testing If both ears are covered by doughnut receivers there is attenuation of ambient noise of 20 db (10 for low and 30 for high frequencies) A room with 50 db noise level is therefore suitable for pure tone and speech audiometry when phones are used The above applies to testing normal ears For pathological ears, a higher noise level is quite satisfactory It is important, however, not to check calibration of an audiometer on normal subjects in a room with higher noise levels

AIR CONDUCTION

In order to test one ear it is often necessary to eliminate the other during the test This is accomplished by masking on the principle that when the neural pathways of one ear are occupied by stimuli, a lesser stimulus from the other cannot be perceived When the stimulus is presented to one ear by ear phones there is a physiological interaction between the two ears This interaction is small, amounting to about 5 db of masking or attenuation There is also a transmission of some

Fig 5



JEFFERSON HOSPITAL
HEARING RECORD

Name W W L

AIR CONDUCTION

	RIGHT							LEFT							
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
12/26/51	45	55	55	55	40	60	45	45	60	55	55	35	40	40	Preop
9/3/52	65	70	80	70	80	80	-	45	45	55	50	35	50	50	Postop

BONE CONDUCTION

	RIGHT					OPP. EAR MASKED		LEFT					
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
11/4/52	5	10	10	30	30	No Mask.		-5	-5	5	30	30	
	5	10	10	35	30	80	W.N.	-	-5	0	30	25	
	20	30	70	40	35	100	W N	0	10	20	30	30	

SPEECH RECEPTION

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
12/26/51	46	43		Sp.	X		
6/5/52	60	42		Sp.	X		
7/28/52	66	41		Sp	X		

HEARING AID

DISCRIMINATION

	RIGHT					LEFT					
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10/30/52	86%	100 db	Pb.	X		96%	91	Pb.	X		
11/4/52	6	100 db	Pb.	X		Masked at 90 db.					

Otosclerosis with unsuccessful fenestration right ear
Cold caloric test gives no response from right ear
Note apparently good hearing in dead right ear even by bone conduction with masking and unmasked speech reception.

of the signal energy to the opposite ear It has been shown that the attenuation across the head is about 40 db for low tones (200-300) 55 db for middle frequencies and 60 db for higher frequencies [1]

The ease with which low frequencies cross the skull is another reason for the difficulty in masking low tones It is apparent, therefore, that whenever there is a difference of 50 db or more between the two ears, masking is necessary to eliminate the possibility of a shadow curve from the better ear To be certain of eliminating crossed hearing, a good rule is to mask for differences of 40 db or more. Stimuli from one ear reach the other by air conduction around the head, through the headband, and by bone conduction Of these bone conduction is the most important.

Table II

MAXIMUM LOSS MEASURABLE BY AIR CONDUCTION FOR SPEECH FREQUENCIES

RIGHT NORMAL EAR	COMPLETE LEFT PERCEPTIVE DEAFNESS
80 db white noise mask produces about 50 db masking (30 db ineffective)	110 db air conduction loss (60 db loss across head plus 50 db loss due to masking)
RIGHT EAR WITH 50 db PERCEPTIVE LOSS	COMPLETE LEFT PERCEPTIVE DEAFNESS
80 db mask produces no masking (30 db ineffective) (50 db not heard)	110 db air conduction loss (60 db loss across head plus 50 db loss due to perceptive lesion)
RIGHT EAR WITH 50 db CONDUCTIVE LOSS	COMPLETE LEFT PERCEPTIVE DEAFNESS
80 db mask produces no masking (30 db ineffective) (50 db not heard)	60 db air conduction loss (loss across head)
100 db mask produces 20 db masking.	80 db air conduction loss
120 db mask produces 40 db masking	100 db air conduction loss

80 db is the maximum intensity of masking that can be used in the opposite ear without stimulating the tested ear, because 50 to 60 db does not cross over, due to the attenuation across the head, and the first 30 db that do are ineffective for masking This is also the maximum level that most patients

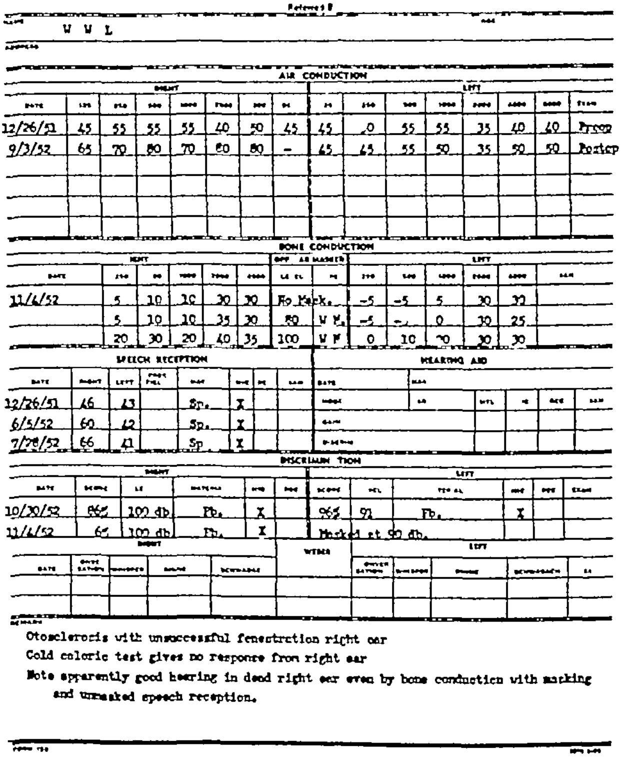
used The above applies to testing normal ears For pathological ears, a higher noise level is quite satisfactory It is important, however, not to check calibration of an audiometer on normal subjects in a room with higher noise levels

AIR CONDUCTION

In order to test one ear it is often necessary to eliminate the other during the test This is accomplished by masking on the principle that when the neural pathways of one ear are occupied by stimuli, a lesser stimulus from the other cannot be perceived When the stimulus is presented to one ear by ear phones there is a physiological interaction between the two

JEFFERSON HOSPITAL
HEARING RECORD

Fig 5



Referred B

W W L

AIR CONDUCTION

DATE	RIGHT							LEFT							
12/26/51	45	55	55	55	40	50	45	45	,0	55	55	35	40	40	Preop
9/3/52	65	70	80	70	60	80	–	45	45	55	50	35	50	50	Postop

BONE CONDUCTION

DATE	RIGHT					EFF. AS MASKED		LEFT					
11/6/52	5	10	10	30	30	No Mark.		-5	-5	5	30	30	
	5	10	10	35	30	50	W N.	-5	-,	0	30	25	
	20	30	20	40	35	100	W N	0	10	20	30	30	

SPEECH RECEPTION

DATE	RIGHT	LEFT	FREE FIELD				
12/26/51	46	43		Sp.	X		
6/5/52	60	42		Sp.	X		
7/28/52	66	41		Sp	X		

HEARING AID

DISCRIMINATION

DATE	RIGHT SCORE					LEFT SCORE					
10/30/52	86%	100 db	Pb.	X		96%	92	Pb.	X		
11/6/52	66	100 db	Pb.	X		Masked at 90 db.					

RIGHT WEBER LEFT

Otosclerosis with unsuccessful fenestration right ear
Cold caloric test gives no response from right ear
Note apparently good hearing in dead right ear even by bone conduction with masking and unmasked speech reception.

ears This interaction is small, amounting to about 5 db of masking or attenuation There is also a transmission of some of the signal energy to the opposite ear It has been shown that the attenuation across the head is about 40 db for low tones (200-300) 55 db for middle frequencies and 60 db for higher frequencies [1]

The ease with which low frequencies cross the skull is another reason for the difficulty in masking low tones It is apparent, therefore, that whenever there is a difference of 50 db or more between the two ears, masking is necessary to eliminate the possibility of a shadow curve from the better ear To be certain of eliminating crossed hearing, a good rule is to mask for differences of 40 db or more. Stimuli from one ear reach the other by air conduction around the head, through the headband, and by bone conduction Of these bone conduction is the most important.

Table II.

MAXIMUM LOSS MEASURABLE BY AIR CONDUCTION FOR SPEECH FREQUENCIES

RIGHT NORMAL EAR	COMPLETE LEFT PERCEPTIVE DEAFNESS
80 db white noise mask produces about 50 db masking (30 db ineffective)	110 db air conduction loss (60 db loss across head plus 50 db loss due to masking)
RIGHT EAR WITH 50 db PERCEPTIVE LOSS	COMPLETE LEFT PERCEPTIVE DEAFNESS
80 db mask produces no masking (30 db ineffective) (50 db not heard)	110 db air conduction loss (60 db loss across head plus 50 db loss due to perceptive lesion)
RIGHT EAR WITH 50 db CONDUCTIVE LOSS	COMPLETE LEFT PERCEPTIVE DEAFNESS
80 db mask produces no masking (30 db ineffective) (50 db not heard)	60 db air conduction loss (loss across head)
100 db mask produces 20 db masking.	80 db air conduction loss
120 db mask produces 40 db masking.	100 db air conduction loss

80 db is the maximum intensity of masking that can be used in the opposite ear without stimulating the tested ear, because 50 to 60 db does not cross over, due to the attenuation across the head, and the first 30 db that do are ineffective for masking This is also the maximum level that most patients

will tolerate comfortably It is important to recognize the importance of the type of hearing loss present in the masked ear to assess the amount of masking produced (see Table II and Fig 5)

The degree of hearing loss measurable by masking the opposite ear is obtained by assessing the total perceptive loss of the masked ear under conditions of masking and adding the attenuation across the head In air conduction measurements, the attenuation across the head is about 60 db for the speech frequencies (5 db physiological interaural masking plus 55 db attenuation) In bone conduction measurements, the attenuation is only a few db The effectiveness of masking will vary with the type and degree of hearing loss in the masked ear, as well as the type of masking sound used (see Table III)

Table III.

MAXIMUM BONE CONDUCTION LOSS MEASURABLE FOR SPEECH FREQUENCIES

NORMAL RIGHT EAR	COMPLETE LEFT PERCEPTIVE LOSS
80 db mask produces 50 db masking (30 db ineffective)	55 60 db bone conduction loss (loss 5 10 db across head)
RIGHT EAR WITH 50 db PERCEPTIVE LOSS	COMPLETE LEFT PERCEPTIVE LOSS
80 db mask produces no masking (30 db ineffective) (50 db not heard)	55 60 db bone conduction loss
RIGHT EAR WITH 50 db CONDUCTIVE LOSS	COMPLETE LEFT PERCEPTIVE LOSS
80 db white noise produces no masking (30 db ineffective) (50 db not heard)	5 10 db bone conduction loss (loss 5 10 db across head)
100 db mask produces 20 db masking	25-30 db bone conduction loss
120 db mask produces 40 db masking	45-50 db bone conduction loss

For white noise, the effective masking is roughly 30 db below the overall noise level With the complex low tone masking noise on many audiometers there is often great variation in its effect on different frequencies The following examples refer to white noise masking Clinicians are aware of the necessity of masking when doing pure tone audiometry Its role in speech audiometry is often neglected (see Figs 2 and 5)

CONCLUSIONS

Whenever there is a difference of 40-50 db between a normal and pathological ear, it is necessary to mask the better ear to eliminate crossed hearing This applies to speech audiometry as well as pure tone

The degree of hearing loss measurable by masking the opposite ear is obtained by assessing the total perceptive loss of the masked ear and adding the attenuation across the head In air conduction measurements, the attenuation across the head is about 60 db for the speech frequencies (5 db physiological interaural masking plus 55 db attenuation) In bone conduction measurements the attenuation is only a few decibels The perceptive loss is assessed on the basis of residual bone conduction in the masked ear under conditions of masking

Eighty db of masking, preferably by white noise, is tolerated by normal ears and does not overmask.

Bone conduction should always be done with masking Otherwise, we are testing only the better ear, regardless of where the oscillator is applied

The difficulty of eliminating crossed hearing in bone conduction measurements by masking an ear with a conductive loss casts doubt on the validity of bone conduction measurements as usually practiced in evaluating suitability for fenestration (see Fig 5)

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EXPERIMENTAL APPROACH TO THE STUDY OF THE COMMON COLD *

ROBERT S GOHD, Ph D (by Invitation),
Boston, Mass

Approximately two years ago our laboratory was set up for the purpose of studying viruses attacking the upper respiratory tract The most common of these viruses with which we are working and the one that has most successfully resisted study, is the cold virus The difficulties, simply put, are problems of diagnosis, of isolation, and of culture

There is no simple, easy way of distinguishing an acute rhinitis of viral etiology from other disorders producing essentially similar clinical symptoms[1] The situation is similar with respect to the cultivation of common cold virus under laboratory conditions Attempts to establish this virus in experimental animals, other than the chimpanzee, has not been satisfactorily accomplished, therefore, it has been necessary to employ human beings for experimental purposes Experiments with this species is expensive, requires a large medical staff, is exceedingly difficult to control, to say nothing of difficulties encountered in obtaining people for such studies

Andrews,[2] of England, has stated his belief, and it is ours also, that the future of cold research lies in the development of laboratory procedures that will facilitate the investigation of colds These problems inherent in studies of the cold have thus defined our task and long range objectives that of establishing criteria for the diagnosis of cold infection and development of techniques for its study in the laboratory

Neither of these objectives has been attained in our laboratory, however in the pursuit of these objectives a few observations quite unrelated to the immediate problem have been made which I consider to be of at least potential importance For example, in tissue cultures it was found that cal-

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* Read by invitation at the meeting of the Eastern Section American Laryngological Rhinological and Otological Society Inc Philadelphia, Pa. January 7 1955

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cium was an essential requirement for the growth of influenza virus[3] By precipitating calcium inside the cells with phosphate, or by binding calcium in a soluble complex with a strong chelating agent, growth of influenza was prevented The addition of calcium to the system completely reversed the inhibition in a specific manner and permitted the normal proliferation of influenza

Another observation was that some adenoid tissues from apparently normal individuals contain what we prefer to call an epithelium stimulation factor

Our problem, in reality is actually two problems the first is growing the virus under laboratory conditions, the second and more important problem is finding some simple, easily observed manifestation of virus activity to indicate its growth and its presence

There are a few reports in the literature indicating that cold virus was grown in tissue culture or some other laboratory medium, however, no changes were detected in the infected tissues, the tissue appeared similar in most respects to normal, uninfected tissues, and the demonstration of viral activity once again required the inoculation of human volunteers.[4, 5] Thus, the tools which would facilitate the study were not supplied, and the problem remained much as before in a static condition

On the basis of these observations, and because of the rather benign nature of the cold, we have adopted the philosophy that the cold virus possibly exerts its effect in a manner more subtle than the pathogenic viruses Since gross effects as cellular necrosis and cellular inclusions do not appear to play a part in the pathogenesis of the cold virus, it seemed possible that the virus affects the intimate processes of the cell, such as multiplication and metabolism What we are searching for is a single reproducible effect of the virus

In view of recent successes attained with the polio virus, the methods of tissue culture are being exploited in our laboratory The polio virus destroys fibroblasts from a variety of tissues employed in cultures. Unfortunately, the cold virus has no such effect, destroying neither fibroblasts nor any other cells that have been challenged with the virus At the present time, the effect of virus on the metabolism of host cells in tissue culture is also being examined

It has seemed to us that many of the ordinary methods for studying viruses have been attempted with the cold virus, therefore in our search for the elusive effect, we do not hesitate to employ unusual or exotic procedures if there is even a remote rationale for such a procedure, and this reasoning led us to the series of experiments that employed adenoid tissue

One approach for growing viruses that cannot infect ordinary laboratory animals, or media, is to graft a tissue from the susceptible host to the ordinarily nonsusceptible laboratory subject and then infect the grafted tissue with virus. There are two reports on the successful cultivation of Herpes zoster employing the technique with human skin[6 7]

This approach was also employed in our laboratory Adenoids that were obtained at the Eye and Ear Operating rooms from ostensibly normal individuals were grafted to the chorioallantoic membrane of fertile eggs incubated for 11 to 12 days The purpose of the experiment was to provide a tissue system, that eventually would be challenged with the cold virus, and then examined for pathologic alterations of the tissue The actual challenge of the graft with virus was uneventful, however, normal grafts independent of virus, produced such striking changes in the embryonic membrane that it seemed of importance to determine the nature of the phenomenon

The schematic diagram in Fig 1 is a cross section of fertile egg incubated 12 to 15 days The structure that is important in the grafting procedure is the chorioallantoic membrane This thin membrane contains two single layers of epithelium, one adjacent to the shell and one layer facing the allantoic fluid (see Fig 2) The membrane is highly vascularized and is the functioning respiratory organ of the developing embryo There is paper-like membrane between the shell and the chorioallantoic membrane, and it is necessary to separate these two structures before grafting This is accomplished by dropped

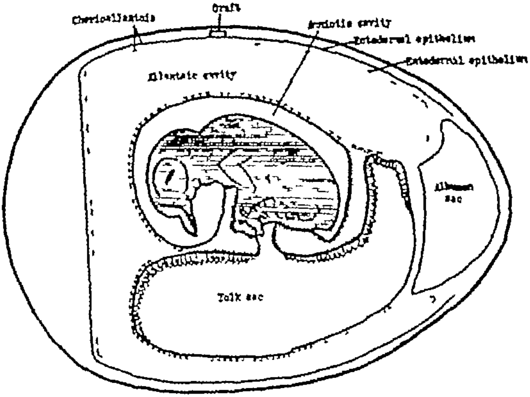

Fig 1. Diagrammatic sketch of a 13-day chick embryo The site of the graft and the two epithelia of the chorioallantoic membrane are indicated.

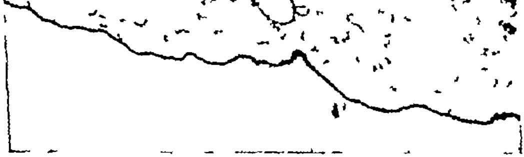

Fig 2. Section of normal chorioallantoic membrane from chick embryo incubated 13 days. The membrane consists of a squamous epithelium (bottom) a single layer of cells that lines the allantoic cavity a middle layer of loose connective tissue that contains blood vessels, and a cuboidal epithelium severals in depth that is in contact with shell membrane (top) x 100.

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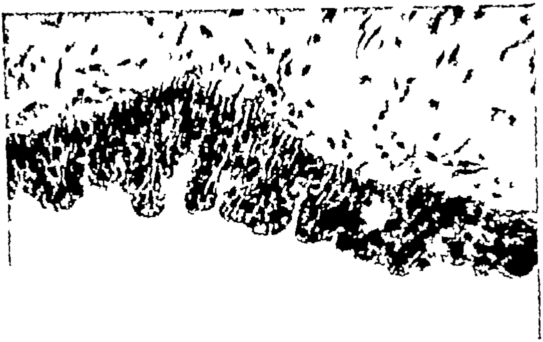

Fig 4 Entodermal epithelium of 14 day chick embryo 48 hours after the grafting of normal adenoid to chorioallantoic membrane The epithelium is papilliform and contains several layers of cells x 430

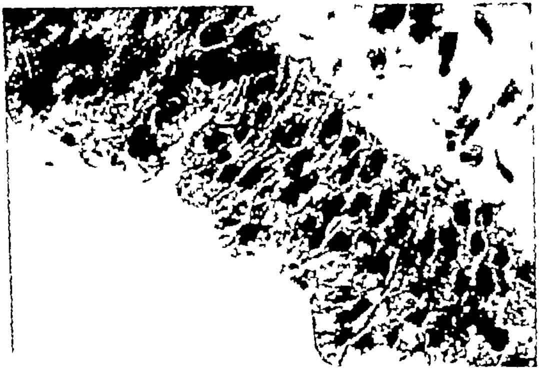

Fig 5 Entodermal epithelium of 14 day chick embryo 48 hours after the grafting of normal adenoid to chorioallantoic membrane The epithelium is papilliform and contains several layers of cells x 870

membrane technique A small hole is made in the shell at the air sac and also in the middle

Sucking the air out of the air sac end creates a false air sac at the middle and separates the allantoic membrane from the shell It is then an easy matter to chip away a circle of shell about 2 cm in diameter without damaging the underlying structures A small piece of adenoid tissue is then put through the defect in the shell and placed directly on the chorioallantoic membrane The defect is covered with Scotch tape and the egg put back into the incubator

Evidence of grafting was apparent after 24 hours, and firm attachment took place within 48 hours This was evident microscopically by the disappearance of chick epithelium that is

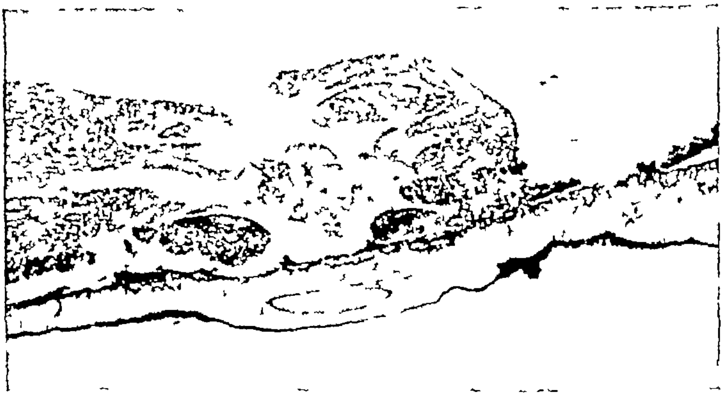

Fig 3 Segment of normal human adenoid grafted to chorioallantoic membrane of 12-day chick embryo After 48 hours portions of the squamous epithelium on the side distal to the graft have formed papillae and are now multilayered × 50 The adenoid frequently is torn loose in the process of sectioning 48 hour grafts.

in direct contact with the graft and by the invasion of the graft by chick fibroblasts A most striking change occurred in the epithelium of entodermal origin, that is the epithelium that was not in contact with the graft but distal to it (see Figs 3, 4, 5)

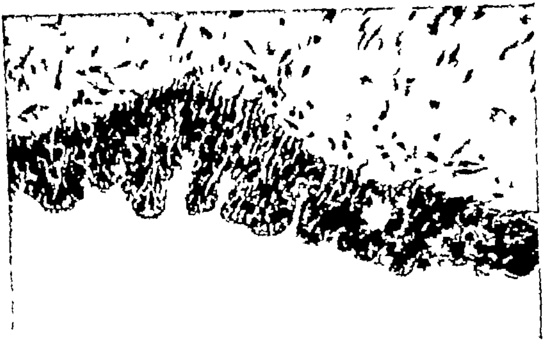

Fig 4 Entodermal epithelium of 14 day chick embryo 48 hours after the grafting of normal adenoid to chorioallantoic membrane The epithelium is papilliform and contains several layers of cells x 430

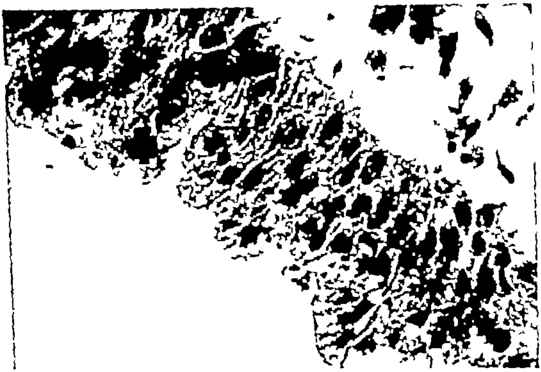

Fig. 5 Entodermal epithelium of 14 day chick embryo 48 hours after the grafting of normal adenoid to chorioallantoic membrane The epithelium is papilliform and contains several layers of cells x 970

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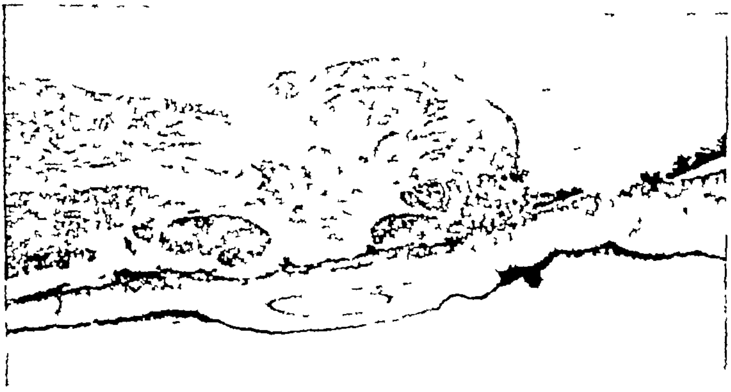

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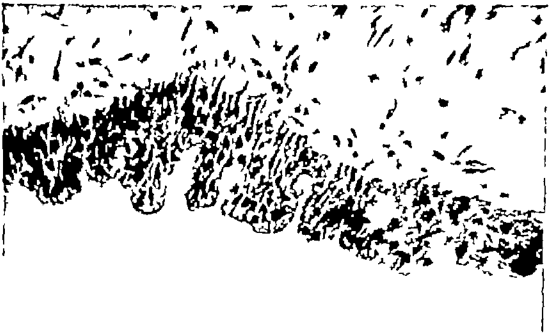

Fig 4 Entodermal epithelium of 14 day chick embryo 48 hours after the grafting of normal adenoid to chorioallantoic membrane The epithelium is papilliform and contains several layers of cells x 430

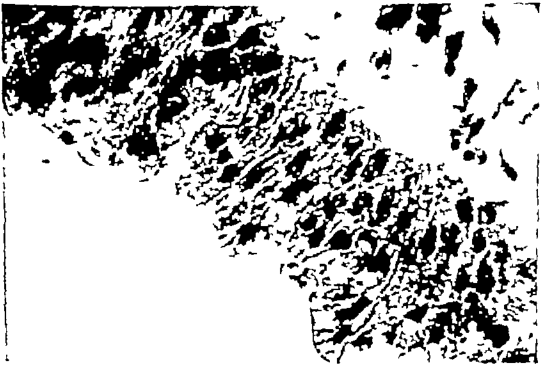

Fig 5 Entodermal epithelium of 14 day chick embryo 48 hours after the grafting of normal adenoid to chorioallantoic membrane The epithelium is papilliform and contains several layers of cells x 970

These are the cells that line the allantoic cavity Hyperplasia and metaplasia were observed The character of the epithelium changed from a thin single layer squamous epithelium to a wildly growing multilayered columnar epithelium On occasion portions of the epithelium appeared undifferentiated, losing its epithelial nature and in some respects resembling tumor tissue (see Fig 6)

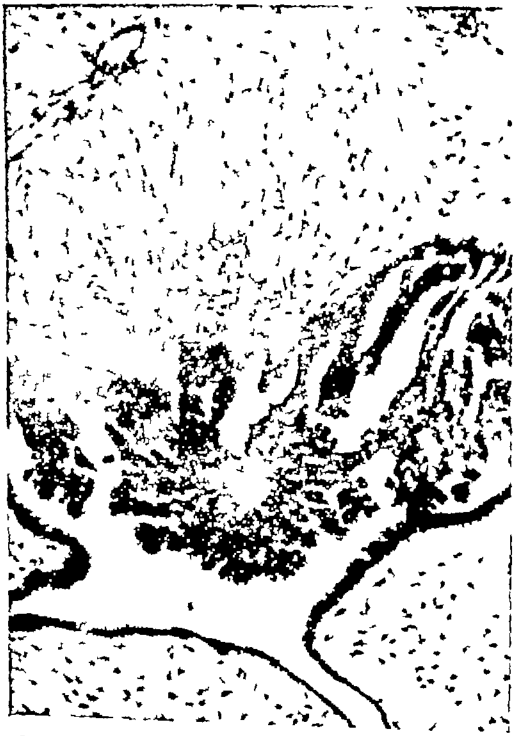

Fig 6 Entodermal epithelium from embryo incubated 15 days and three days after the grafting procedure The chorioallantoic membrane has invaginated Portions of the entoderm has lost its epithelial character and has formed a growth that resembles tumor tissue × 100

As early as 24 hours after the placement of the adenoid, proliferation of the entoderm could be detected The epithelium increased in height and in concentration of cells and reached a maximum at 48 to 72 hours Degenerative changes were observed at 96 hours The epithelium apparently became friable, and portions of it were frequently sluffed Sections made at this time showed patches of membrane without epithelium

At 96 hours and later the middle portion of the membrane became filled with increasing quantities of connective tissue The adenoid itself underwent a considerable change, as a result of the grafting procedure At first the lymph follicles were filled with lymphocytes At 48 and 72 hours there was evidence that the graft was being invaded by embryonic blood vessels, and chick erythrocytes were seen in these vessels Lymphocytes decreased in number Ten days after grafting and a day or two before hatching the graft was highly vascularized, filled with new blood vessels and virtually devoid of lymphatic tissue

The grafting procedure, as well as the development of the graft, proceeded without a deleterious effect on the embryos Chicks hatched in good condition at about the same time as the controls without adenoids.

In regard to this phenomenon the following observations have been made It was found that the method of placement of tissue was important The adenoid tissue is generally incubated in an antibiotic solution for an hour and then it is cut into several small pieces One piece is added to each egg If the surface epithelium of the adenoid was placed next to the membrane, the graft did not fuse with the membrane and no stimulation of entoderm occurred It was necessary to place a newly cut surface adjacent to membrane for a successful graft.

During the course of the work we wondered whether the increase in the number of cells of the entoderm was due to a stimulation by some soluble factor elaborated by the adenoid that diffused into the membrane, or whether it was actually the migration of adenoid cells to the entoderm The next two experiments indicated that the apparent stimulation was not migration of cells but was caused by some soluble element, either present in the adenoid or secreted by it.

The first experiment examined the possibility of migration of cells Adenoid tissue was incubated first in a vital stain, trypan blue, and then grafted to the chick embryo The stain labeled the adenoid cells by dyeing them blue The degree to which they migrated into the embryonic membrane could be observed, merely by examining sections of the membrane underlying the graft for blue stained cells

Blue material of adenoid origin was observed in the middle or loose connective tissue area of the chorioallantoic membrane The cells containing the stain appeared to be phagocytic cells The nature of this experiment was such that it could not distinguish between phagocytes of adenoid origin that had migrated to the embryonic membrane and phagocytes of embryo origin that had engulfed adenoid material The most important fact brought out by this experiment was that blue stained cells never were observed in the entodermal layer of epithelium This indicated that the apparent stimulation of of epithelium was not caused by a migration of adenoidal cells from the graft

A second series of experiments were performed to determine whether the intact adenoid segment was required for epithelial stimulation Accordingly, extracts that were free of cells and tissue homogenates were prepared from adenoids Both of these substances proved to be active, however, the stimulation induced by extracts was not as great as with the intact adenoid These results suggested that this factor was either a small foreign substance that was present in the adenoid at time of grafting, such as a virus, or was a soluble substance elaborated by the adenoid tissue, such as a hormone or growth factor

A serious effort was made to demonstrate a transmissible agent, that is a possible virus, since our laboratory was oriented towards virology So far our attempts have been unsuccessful, no agent has been isolated

The stimulation appears to be specific for adenoid Several tissues have been tested, including tonsils and corneas of human and bovine origin Other laboratories have employed skin and muscle in similar procedures apparently without producing an effect on the allantoic entodermal cells The activity does not seem to be an inherent property of lymphoid tissue, although we have not tested all sources of such tissue

A disturbing factor that has troubled us is that all adenoids do not possess epithelial stimulation activity Roughly, 40 to 50 per cent of all adenoids grafted were active, 90 per cent of the grafts were successful, but only about half of these produced changes in the allantoic entoderm We do not know why adenoids from certain normal individuals possess activity and adenoids from others do not. Failures could not be correlated with the age of the donor Epithelium stimulation was observed with adenoids from young children, adolescents and young adults Failures could not be related to the differences of sex. Time of the year may be an influential factor The percentage of adenoids having the stimulation factor was higher for those examined during the Winter than those for the Summer months, however, the differences may not be significant.

At the start of the adenoid phase of our investigation it seemed important to explore the phenomenon of epithelial stimulation because of its possible relationship to the cancer problem Information regarding factors that stimulate or limit cellular growth would certainly be of value in the ultimate understanding of carcinogenesis Carcinogenesis, vitamin, hormone and virus have been considered as the possible etiology of the epithelium stimulation

Because the epithelium undergoes necrosis after four days and apparently never develops an invasive or malignant property, the theory of a carcinogenic activity of adenoids has been temporarily discarded Vitamin A produces marked changes on squamous epithelium in tissue cultures stimulating growth of the cells and changing them to columnar ciliated cells It is also well known that certain hormones produce tremendous cyclic proliferative changes in the endometrium of the female Both of these possibilities have been considered The fact that homogenates and extracts of adenoid tissue are active is consistent with hormonal or vitamin stimulation, however, the sporadic behavior, that is the differences observed between different adenoids, militates against this thesis

Most of the observed data is consistent with a viral etiology as the cause of the epithelial stimulation The very erratic nature of the adenoids can be accounted for on the basis that certain ones harbor a latent or masked virus Adenoids possessing activity would be those containing virus, adenoids without activity would be devoid of virus According to Rivers in his text, stimulation of epithelium, followed by necrosis, is consistent with the pathogenesis of virus infection of cells This has been observed with certain animal viruses, as well as with vaccinia virus

The production of pathology in the allantoic membrane, by employing inocula of either extracts or tissue homogenates, fortifies the virus thesis Were it not for the fact that the transmission experiments were negative the thesis of virus etiology would be highly plausible The results of an investigation that was reported recently may provide the answer to our negative experiments

Huebner[8] and his associates at the National Institute of Health, and in collaboration with a group at Johns Hopkins, have been isolating viruses from the nose and throat Over 100 strains of what they term adenoidal-pharyngeal-conjunctival agents have been isolated by them, 43 strains have been isolated from adenoid and tonsillar tissue removed surgically from normal individuals These agents are characterized as cytopathogenic for HeLa cells in tissue culture

A peculiar phenomenon is that the adenoid virus can not be isolated directly by culturing of these HeLa cells because it is in a "masked" form in the adenoid tissue It is first necessary to culture the adenoid for prolonged periods in roller tubes This unmasks the virus, and it then can readily be grown in HeLa cultures

This report thus provides a possible explanation for our observations Our inability to transmit epithelium stimulating agent may be due in fact to a masking mechanism similar to that reported by Huebner

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NEW YORK EYE AND EAR INFIRMARY ALUMNI ASSOCIATION DINNER

A subscription dinner honoring Edgar B Burchell, D Sc. on the completion of 60 years of distinguished service at the New York Eye and Ear Infirmary, will be given on June 10 1955, at the 7th Regiment Mess, 643 Park Avenue, at 67th Street, New York City Cocktails and reception at 6 30, dinner at 7 30 P M For further information write to Dr Joseph H Krug Secretary-Treasurer, Alumni Association New York Eye and Ear Infirmary, 218 Second Avenue, New York City

SECONDARY RADICAL NECK DISSECTION *

JOHN J O'KEEFE, M D ,
Philadelphia, Pa

Failures in the surgical management of cancer of the larynx are commonly observed as either local recurrences or as regional metastases Local recurrences usually occur when the magnitude of the primary operation is less than total laryngectomy, *i e*, following any form of cordal resection, such as the laryngo-fissure operation, or the endolaryngeal resection technique Failures following laryngectomy may occur as local recurrences but occur mostly as cervical metastases Such metastases less frequently are the manner in which thyrotomy failures are also first manifested Needless to say, in many instances the first indication of failure in the treatment of this malignancy is made through the identification of a remote or organ metastasis, regardless of the type of primary operation

Recurrences within the larynx, following thyrotomy, indicate inadequate surgical resection of the primary cordal lesion[1,2,3] Ordinarily a more radical technique, laryngectomy, is employed as the corrective measure for this type of recurrence, but it may be that a revision of the initial thyrotomy can effectively resect this lesion Further consideration of this type of failure is not relevant to this study It is of pertinent importance, however, to accept as fact that the detectable presence of cervical lymph nodes following operation for cancer of the larynx constitutes presumptive evidence of malignant metastases Immediately one must appreciate the greater seriousness of this failure, as compared to local recurrence, for now the disease has extended beyond the confines of the larynx and is threatening general body dissemination It must be understood that in such circumstance, if cure is to be obtained it can be only through wide field radical neck resection

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The inadequacy of the primary operation as herein referred to, is not simply a reflection of error in judgment or of the improper selection of operation, but rather implies the presence of an undetected or undetectable microscopic metastasis at the time of operation. In like manner, it may appear that the development of regional metastasis voids the rational appraisal of the various criteria that characterize a tumor and nullifies an operation well performed and presumably properly selected. Statistics pertaining to primary five year cures correct this misrepresentation. Based solely on the proper appraisal of these accepted criteria, operations are correctly selected in from 70 per cent to 85 per cent of cases.[1,2,3,4]

The issue being undertaken at this time, however, is not the selection of the primary surgical procedure for cancer of the larynx but rather to discuss the fate of those individuals who do develop regional metastases following either thyrotomy or laryngectomy, and who are then subjected to secondary radical neck dissection.

The management of cervical metastases of previously operated laryngeal cancer is a complicated problem. Consideration and appraisal of the initial lesion, the primary operative procedure performed, the apparent extent of the local metastasis and a diligent search for remote metastases must be made and evaluated in order to plan for the surgical resection of this malignant cervical mass.

THYROTOMY

As defined in a previous report, the operation of thyrotomy should be elected in instances wherein the "carcinoma is so situated as to be entirely contained on the anterior or middle thirds of the vocal cord, without involvement of the anterior commissure or extension to the opposite cord, without subglottic extension or extension into the ventricle, and without any evidence of impairment of motility."[5] According to this definition then, properly selected cases operated by the technique of thyrotomy should, and ordinarily do, result in a reasonably high percentage of primary surgical cures.

Failures following primary thyrotomy, including both local recurrences and local metastases, are currently reported as varying between 13 per cent and 20 per cent in large series of cases[2,3] Local recurrences obviously are due to incomplete removal of the initial lesion Secondary surgery in these instances, depending upon the extent of the recurrent growth, consists either of a revision thyrotomy or of a laryngectomy Statistics relative to this type of corrective surgery are not pertinent to this issue Local metastases, on the other hand, do not reflect on the inadequacy of the primary surgery, and although less frequent in occurrence, pose a more serious problem Radical neck dissection, usually combined with laryngectomy, is the only surgery suitable to this contingency

LARYNGECTOMY

Cordal growths which fail to conform to the definition stated as acceptable for thyrotomy, and/or lesions originating on the epiglottis, the sub-glottic area, or the aryepiglottic fold, but without evidence of extension either to the lateral pharyngeal wall, the base of the tongue, or of regional or remote metastases, are suitably selected for primary laryngectomy When we resort to laryngectomy according to this definition it, too, is accompanied in many instances by a reasonably high cure rate

Recent statistics[4,5] report that failures following primary laryngectomy, noted as regional lymph node metastases, occur in from 20 to 30 per cent of cases, yet little is reported in the literature concerning the ultimate disposition of these patients, other than the fact that they are then subjected to either irradiation therapy or to neck resection

Examination of these and current statistics also reveals that surgical failures following laryngectomy are of a higher incidence than are those following thyrotomy The reason for this is apparent when one realizes that with more extensive lesions necessitating more radical primary operations, the more likely it is that metastases are present but undetectable at the time of initial operation As applied to the clinical picture of cancer of the larynx it is apparent also that as one is obliged to advance from the operation of laryngofissure to that of laryngectomy as the initial surgical procedure, primary cures are less feasible, and the probability of regional metastases is increased

INDICATIONS AND TECHNIQUE

The indication for secondary radical neck dissection consists essentially of the presence of cervical metastases following operation on the larynx for carcinoma To qualify this indication, it should be added that such cervical masses should be relatively mobile, that there be no evidence of remote metastases, that the general physical condition of the patient will tolerate such an extensive procedure and that there is no evidence of residual carcinoma within the pharynx

STATISTICS

The following cases of secondary radical neck dissection, 71 in number, are the cases so operated as representing this type of surgical failure selected from more than 1100 primary operations on the larynx for cancer there were 552 cases of laryngofissure and 613 cases of laryngectomy The 71 cases here reported do not represent the total number of failures following primary operation but only those which fitted the indications for secondary radical neck dissection as described previously

TABLE I

Type of Primary Operation	No	Survived P o Year				Deaths
		2	3	4	5	
Thyrotomy	11				7 (63 6%)	4
Laryngectomy	60	3	2	6	24 (40 0%)	23 2 (not CA)
Laryngectomy and Block Dissection	9	1	1	2	3 (33 0%)	2
Totals	80				34 (42 5%)	31

Of the thyrotomy failures exhibiting cervical metastases, radical neck dissection was performed in 11 instances Of these 11 patients, seven are living and well five or more years postoperatively, and four are dead of cancer Of the laryngectomy failures similarly identified by way of palpable cervical lymph nodes radical neck dissection was performed on 60 such patients, of whom 24 are living and well five or more varying between 13 per cent and 20 per cent in large series of cases[2,3] Local recurrences obviously are due to incomplete removal of the initial lesion Secondary surgery in these instances, depending upon the extent of the recurrent growth, consists either of a revision thyrotomy or of a laryngectomy Statistics relative to this type of corrective surgery are not pertinent to this issue Local metastases, on the other hand, do not reflect on the inadequacy of the primary surgery, and although less frequent in occurrence, pose a more serious problem Radical neck dissection, usually combined with laryngectomy, is the only surgery suitable to this contingency

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In addition to these cases, there were also operated upon nine patients with metastases occurring to the contralateral side of the neck following the procedure of one-stage laryngectomy and radical neck dissection Of this group of nine, three are living and well for a period of five years or more and four for a period of less than five years following their second operation, two are dead of cancer

DISCUSSION

Secondary radical neck dissection in the treatment of cancer of the larynx is a procedure devised to salvage primary surgical failures manifesting regional metastases In evaluating the failures so operated, of first significance is the fact that by means of this operation lives are saved This is the primary consideration in the treatment of cancer in any part of the body Secondarily it is also appreciated that the incidence of cervical metastases increases directly with the extent of the primary lesion

The results to be derived from this evaluation are that first, following primary laryngectomy, cervical metastases have occurred in a relatively large percentage of instances—20 to 30 per cent This bespeaks principally of inadequate primary surgery, thereby signifying the need and rationale for the technique of the one-stage laryngectomy with radical neck dissection The one-stage combined operation is positively indicated wherein cervical nodes are palpable at the time of initial operation, and relatively indicated where, because of the extent or position of the carcinoma, one suspects the presence of or anticipates the early development of cervical metastases It is only by accepting this combined procedure as a primary operative technique that the incidence of metastases following surgery for cancer of the larynx will be reduced Second, of the failures manifesting cervical metastases which comply with the indications for secondary radical neck dissection, although a large proportion of these patients are salvaged by means of this secondary operation, more cases would be found suitable if their metastases were diagnosed before fixation occurred Experience has shown that surgery cannot completely resect cervical metastatic masses that are fixed to the underlying bony structures Third, the limitations of secondary surgery to effect cure in some cases of local metastases, together with the complete inoperability of remote metastases, emphasizes the unjustifiable attitude sometimes assumed in reserving one operative procedure in the event of failure of the first procedure The fate of such patients too often is determined long before secondary surgery is attempted

SUMMARY

An evaluation of the failures of primary surgery of the larynx for cancer is reported, with special consideration as to the cause of such failures

The surgical management of cervical metastases is described, together with the results obtained in 80 cases of secondary radical neck dissection

It is defined that secondary radical neck dissection, as a salvage procedure, is warranted and rewarding

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OTITIS MEDIA—THEN AND NOW *†

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The purpose of this paper is to compare the results of treatment of otitis media in the pre-sulfa, the sulfa and the penicillin periods, and to summarize what we think are the best methods of treatment available at the present time. The data presented are derived from our experience in the Department of Otolaryngology at the Geisinger Memorial Hospital since 1932. Table I shows the dramatic reduction in the number of mastoid operations.

TABLE I

DECREASING INCIDENCE OF "SIMPLE" MASTOID OPERATIONS AT THE GEISINGER HOSPITAL

Year	Period	No. Cases *Acute* Otitis Media and Mastoiditis	No. "Simple" Mastoid Operations	Per Cent Requiring Mastoidectomy
1937	Pre-sulfa	202	119	58.9
1943	Sulfa	282	74	26.2
1946	Small dose penicillin	247	10	4.0
1949	Large dose penicillin	189	5	2.7
1950	(1-3 million units daily)	158	9	5.7
1951	(1-3 million units daily)	109	1	0.9
1952	(1-3 million units daily)	110	3	2.7
1953	Larger dose penicillin	122	0	0
1954	(5-10 million units daily)	65	2	3.0

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† From the Department of Otolaryngology, The Geisinger Memorial Hospital and Foss Clinic.

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Someone may possibly comment that the percentage of mastoid operations in the earlier years was much too high I do not think this comment is valid, because my indications for mastoidectomy have remained the same This series does not include acute exacerbations of chronic mastoiditis nor does it include radical or modified radical mastoid operations During the past four years we have done 81 radical and 28 modified radical mastoid operations I think the comparison over a period of years is valid, because these patients came from a stable community They came to the hospital because their symptoms had not been cleared up with the methods and drugs utilized by the family physician In each period the family physician had at his disposal the same drugs which were available to us, but in most instances the drugs were used in smaller doses and for too short a period of time

Over this period of 18 years the number of patients admitted to our service for *all* types of disease has slowly *increased* until 1954, when over 1,000 patients were admitted to this service This was 8 5 per cent of all hospital admissions The decreased number of patients admitted during the last four years for treatment of acute otitis media and mastoiditis would seem to be evidence that the family physician is curing a higher percentage of these patients than he did during the preceding years

TABLE II

DEATHS FROM COMPLICATIONS OF OTITIS MEDIA—PRE-SULFA PERIOD

1932	Septicemia (1) Meningitis (3)	4
1933	Meningitis	3
1934	Meningitis	1
1935	Septicemia	1
1936	Meningitis (3) Nephritis (1)	4
1937	Brain abscess	1
1938	Meningitis (2) Brain abscess (1)	3
7 years	Deaths	17

Average number of admissions per year—737

Tables II, III and IV show the decreasing death rate from the complications of otitis media Note that since 1950 there have been no deaths Since 1946 I have not used the sulfonamide drugs except for patients with meningitis, therefore our low mortality rate since that time can properly be attributed to the judicious use of penicillin.

TABLE III

DEATHS FROM COMPLICATIONS OF OTITIS MEDIA—SULFA PERIOD

1939	Meningitis	2
1940	Meningitis	1
1941	Meningitis	1
1942		0
1943		0
1944		0
6 years	Deaths	4

Average number of admissions per year—721

TABLE IV

DEATHS FROM COMPLICATIONS OF OTITIS MEDIA—PENICILLIN PERIOD

1945	Meningitis	1
1946		0
1947		0
1948		0
1949		0
1950	Meningitis (1) Brain abscess (1)	2
1951 - 1954		0
10 years	Deaths	3

Average number of admissions per year—948

The fact that penicillin is superior to the sulfonamide drugs was also well demonstrated by Wilcox[5]. Of the 247 patients with acute otitis or mastoiditis in Wilcox's 1945-1946 series, 118 were first treated with sulfadiazine, because at that time penicillin was comparatively expensive. In 42 per cent of these cases, use of sulfadiazine was discontinued, and penicillin was administered either because the infection failed to improve or because signs of sulfonamide intolerance developed. It is surprising that the results of penicillin therapy were good, as judged by 1945-1946 standards, because only 20,000 to 50,000 units were given intramuscularly every three hours, however, that was in the days before many organisms had become relatively resistant to the action of penicillin.

Davis and McDermott[1] state: "The introduction of more potent and less toxic agents has relegated the sulfonamides to the role of drugs useful in only specialized situations."

House[3] in 1946 presented an interesting comparison of the results of treatment of otitis media before and during the sulfonamide period In his 1935, or pre-sulfa series, 45 9 per cent of the patients required simple mastoidectomy In his 1943 series of cases, treated with one of the sulfonamide drugs 17 6 per cent of the patients required simple mastoidectomy

It should be realized that acute otitis media and acute mastoiditis are not two separate and distinct processes There is some degree of mastoiditis with every otitis media which has persisted for more than three or four days If this mental picture were firmly planted in the minds of all physicians treating otitis media I think there would be less tendency to delay early myringotomy and early administration of one of the antibiotics

Rutherford[4] makes some biting but well-founded comments as follows "The complacent acceptance of the antibiotics as a cure-all in acute otitis media has led to a state where the younger pediatricians do not know the art of cleansing the ear canal, of observing and recognizing the changes in the tympanic membrane which indicate pathologic conditions in the middle ear, or how to do a myringotomy " "In fact, some of these young men and women have been taught that myringotomy is not only an unnecessary procedure but also one to be avoided because it injures and scars the tympanic membrane, although spontaneous rupture of the drum under antibiotic therapy apparently is not considered harmful They do not differentiate between suppurative and non-suppurative acute otitis media."

The obvious answer is that otitis media should be treated only by those physicians who have the manual skill to cleanse the canal adequately and to determine by use of the *pneumatic ostoscope* whether or not there is fluid in the middle ear In my opinion fluid in the middle ear, whether it is suppurative or non suppurative, should *always* be evacuated by myringotomy and aspiration. I think following myringotomy the exudate in the middle ear should be evacuated with a small spot suction tube I prefer a glass tube because it shows me the character and quantity of fluid removed It also furnishes a reliable sample of exudate for smears and cultures

Rutherford[4] also states "Natural immunity may not be acquired when drugs are used and the organisms may regain their former activity when the drug is discontinued" This in my opinion is a theoretical consideration which should not deter us from early administration of penicillin The almost complete elimination of simple mastoid operations all over the country since the introduction of penicillin would seem to be sufficient evidence to warrant continuation of its use

It seems pointless to argue whether use of penicillin is superior to use of myringotomy or vice versa The sensible attitude is to employ *both* measures as soon as the diagnosis is made During the last ten years I have not had to perform a mastoidectomy for any patient who came to me for initial treatment of the otitis media

Men in our department have done only six simple mastoid operations during the past four years The indication for operation in four cases was subperiosteal abscess, in one case facial paralysis and in one case meningitis The history of each case indicated that myringotomy had *not* been performed and that penicillin had *not* been used or, if used, was given in small dose That brings up the question of what *is* an adequate dose of penicillin Obviously, natural resistance plays a major role in control of all infections, and if resistance is good relatively small doses of any antibiotic *may be* effective

The *site* of the infection as well as the degree of penicillin sensitivity of the infecting organism must be taken into account in determining the size of the daily dose and the duration of treatment There is something about infections in bone-surrounded cavities which makes them respond poorly and slowly to average doses of penicillin Probably it is the fact that inflammatory swelling of soft tissues surrounded by bone constricts the blood supply to these tissues

I agree with Eagle[2] and associates, who suggest that "A large dose may promote the penetration of penicillin into walled-off foci of infection, which are only slowly equilibrated with the tissue fluids, and into which penicillin might not diffuse in adequate concentration after a small dose which provides a low head of pressure for a relatively brief period" It is with this thought in mind that I have used fortified procaine penicillin ever since it has been available, and our results have been so gratifying that I shall continue its use

A common but frequently ineffectual program is one injection of penicillin followed by penicillin by mouth for three or four days Only one-fifth of the penicillin taken by mouth is absorbed, so it seems rather foolish to rely on this mode of administration We see many patients who have not been cured by small doses, but who do respond promptly to three or five million units of fortified procaine penicillin daily if this dose is continued for five to eight davs

In reviewing the charts of our last 25 patients I find that we usually give 3,000,000 units daily for children under six years of age and 5,000,000 units daily for those over six years of age Some of the adults were given 10,000,000 units daily because they had mastoid tenderness Several who had marked tenderness and edema over the mastoid process were cured without operation Two of these 25 patients had infections due to a staphylococcus which grew on the five-unit penicillin plate, so they were treated with erythromycin 2 Gm daily for a period of seven days, with prompt resolution of the infection

Incomplete resolution can be determined if one uses a pneumatic otoscope Impaired mobility of the drum is an indication for repeated myringotomy and *aspiration* of the exudate in the middle ear The so-called 'masking effect" of the antibiotics is no problem for the man who is experienced in the use of these procedures A normal audiogram is additional evidence of a normal middle ear

In order to diminish the tendency for emergence of resistant strains it is desirable to prescribe from the outset a dose schedule sufficient to insure maintenance of an optimum concentration of the antibiotic in the body fluids until clinical symptoms of the infection subside After the symptoms have subsided it is advisable to continue use of the antibiotic for a period of 48 hours and then discontinue its use without a tapering off period Only two of the 25 patients required 5,000,000 units a day for as long as 12 days

Regardless of all that has been said about the value of *in vitro* sensitivity tests, the really dependable means of assessing the effect of an antibiotic in a given case is the therapeutic response It is a fairly reliable rule that if an adequate amount of the right antibiotic is adminstered, marked clinical improvement will be evident within 48 hours If such is not the case, *in vitro* sensitivity tests should be made if they have not already been done

I have used tetracycline for a few patients, but not enough to be confident that it is as effective as penicillin for the average patient with otitis media and early mastoiditis Most cases of otitis media are due to one of the Gram positive cocci, and in our experience, penicillin if given in large enough dose and by intramuscular injection, is still the drug of choice for treatment of most of these infections If the *in vitro* sensitivity tests show that the organism is a staphylococcus which grows on the five-unit penicillin plate, I then use erythromycin

A review of the charts of 25 children with acute otitis media showed that 76 per cent had an enlarged adenoid This fact coupled with the histories of children whose repeated attacks of otitis media ceased following adenoidectomy indicates than an enlarged adenoid is one of the factors predisposing its owner to the development of otitis media Thirty-two per cent of these 25 also had the allergic or atopic constitution This, I believe, is another of the factors predisposing to the development of otitis media, because 10 per cent is the incidence of the allergic constitution in the general population

For a long time I have been skeptical about the effectiveness of glycerine ear drops, because I have seen so many patients who were not cured by their use The highly colored advertisements which we all receive frequently imply that the "highest specific gravity glycerine" will extract fluid from the middle ear through an intact drum by osmotic action To test the validity of this idea last summer my son and I used three anesthetized cats as experimental animals

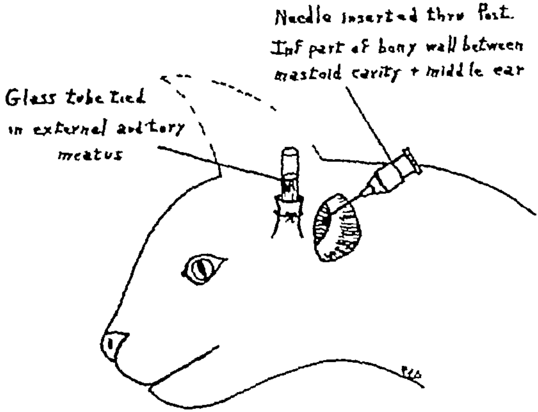
Needle inserted thru Post.
Inf part of bony wall between
mastoid cavity + middle ear
Glass tube tied
in external auditory
meatus

Fig 1 The glass tube in the external auditory canal contains glycerine The middle ear was filled with colored normal salt solution by injecting it as shown in the diagram.

Using the same illumination and magnification one does for a mastoid operation in the human we removed the mastoid cortex and with a hypodermic needle injected normal salt solution colored with methylene blue into the middle ear through the thin plate of bone separating the mastoid cavity from the middle ear The blue-tinted fluid was clearly visible through the translucent drum, and we could thus be certain that there were no air bubbles preventing intimate contact between the fluid and medial surface of the drum The auricle was removed and a snugly fitting glass tube was inserted into the external ear canal The 'cuff" of the membranous canal was tied with a purse string suture to insure a watertight joint The "highest specific gravity" glycerine was used to fill the external ear canal and the glass tube inserted into it The height of the glycerine column was measured at that time and then one hour later

In each of the three experiments the fluid column rose only 2 mm during a period of one hour After measuring the internal diameter of the glass tube we calculated that 0 014 cc. of fluid had been added to the glycerine already present in the external canal and glass tube Some of this fluid undoubtedly came through the drum because in two cases, after one hour the glycerine had a slight bluish tinge The quantity of fluid extracted from the middle ear over a period of one hour was so small that I would hesitate to recommend glycerine ear drops as a means of evacuating fluid from the middle ear

CONCLUSIONS

1 Surgical mastoiditis can and should be prevented by early myringotomy and by early and continuous administration of large doses of one of the antibiotics, perferably penicillin by intramuscular injection

2 The effective dose is usually 3,000,000 to 5,000,000 units daily, but some cases may require as much as 10,000,000 units daily

3 Use of the antibiotics should be continued until the appearance and mobility of the drum are normal, usually five to eight days

4 Recurrence of exudate in the middle ear requires repeated myringotomy and aspiration, using a spot suction tube

5 Glycerine ear drops are a very poor substitute for myringotomy and aspiration

6 The incidence of acute otitis media is higher in children having an enlarged adenoid

7 The incidence of acute otitis media is higher in children having the allergic or atopic constitution

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CORRECTION

In the paper "The Control of Post Operative Bleeding with Adrenosem" by Dr Capers B Owings, published in THE LARYNGOSCOPE for January, 1955, an error appears. On page 23 the paragraph 'Adrenosem has shown, etc." should read Adrenosem has shown no cumulative effect on human subjects treated for over two years and no toxic effects attributable to the drug There is a high index of therapeutic safety at the usual dosage levels, and there seem to be *no* contraindications

This also applies to the reprints of the paper

SINUS DISEASE AND ASTHMA THE PROBLEM OF FOCI OF INFECTION*†

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INTRODUCTION

The relationship of sinus disease to systemic diseases has been a troublesome and confusing problem, in fact, the entire concept of foci of infection[1] of the upper respiratory tract has been questioned often by internists and pediatricians The reason for this changing viewpoint must be that the results of therapy have been unfavorable It is our opinion that rhinologists have been largely responsible for much of this confusion We think that rhinologists in the past have considered upper respiratory disease too frequently as foci of infection, when no real infectious process existed

Four years ago, a clinical research unit, including an allergist and a bacteriologist, was formed in the Department of Otolaryngology at The Mount Sinai Hospital to study particularly the relationship of nasal and sinus disease to systemic diseases This group functioned in a special clinic one morning a week for three years The purpose of this study was to use precise and bacteriologically valid criteria of infection as offered by Goldman [2 a-b] to determine the presence or absence of infection

In this paper we shall present our findings in bronchial asthma, which was the largest group of cases studied We shall try to show

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that only the systematic application of definite criteria of infection to nasal and sinus disease can lead to a logical understanding and clarification of the problem.

It should be pointed out that the gross character of the secretion in the nose or obtained from a sinus, regardless of amount, color or consistency, is no index of the presence or absence of infection. Copious thick yellow secretion can be the manifestation of an active vasomotor rhinitis or sinusitis while scant thin, mucoid secretion can show evidence of active and virulent infection. Also, it should not be assumed that alterations in the mucous membrane of a sinus necessarily indicate infection.

True infection implies not only the presence of micro-organisms but also their active multiplication. It also should be stated that infection always begins on the surface of the mucous membrane and invades the deeper tissues in instances where it becomes uncontrolled and causes necrosis of the mucosa.

It is necessary to define the terms pathogenic, potentially pathogenic and non pathogenic micro-organisms. Diplococcus pneumoniae, streptococcus hemolyticus, hemophilus influenzae and parainfluenzae, and klebsiella pneumoniae are considered pathogenic, even when isolated in small numbers from nasal or sinus secretion. Staphylococcus aureus A, streptococcus viridans, streptococcus non hemolyticus, bacillus proteus and pseudomonas aeruginosa are potentially pathogenic and are considered pathogenic only when found persistently or in moderate to large numbers. Staphylococcus albus, staphylococcus aureus B, diphtheroids and neisseria pharyngis are as a rule non pathogenic.

MATERIAL AND METHODS

One hundred and nine asthmatic patients were referred to the research clinic for study of foci of infection in the nose and sinuses. It should be emphasized that most of these patients were referred because it was believed that infection in the upper respiratory tract was a causative factor in their asthma. The investigation included in most of the patients' Roentgen examination, diagnostic lavage of the maxillary antrums and sphenoid sinuses, and cultural and microscopic examination of the nasal, sinus and nasopharyngeal secretions by the method described by Goldman.

Eighty-two of the patients referred to the clinic had a complete allergic and bacteriologic study and, therefore, are included in this report Fifty eight patients showed no evidence of clinical sensitivity, and their skin tests were either completely negative or gave only scattered slightly positive reactions They were, therefore, placed in the group termed 'intrinsic asthma''

Twenty-four patients showed definite clinical sensitivity, and their skin tests showed marked positive reactions They were placed in the group termed ''extrinsic asthma''

An additional study was made in a group of 16 patients with intrinsic asthma who showed thickened mucous membrane of the sinuses on X-ray examination The membranes were removed at radical antrum operations, or by trephine biopsy Cultural and microscopic examinations were made of the sinus secretion preoperatively The membranes were triturated and cultured on blood agar plates and in broth They were sectioned serially and prepared for both histological study and for demonstration of bacteria

A follow-up study of sinus surgery in 61 asthmatic patients is included These patients had been selected for operation because of persistent sinus disease with abnormal membrane In one group of 30 cases, sphenoethmoidectomy and intranasal antrotomy were performed In the second group of 31 cases, these procedures were supplemented by radical antrum operations

OBSERVATIONS

1 *Bacteriology of Sinus Secretion in Asthma*

Bacteriologic studies were made on the antral secretions of 82 patients The secretions were sterile in 12 instances, yielded non pathogens in 21, potential pathogens in 35, and pathogens in 14 (See Table I)

Among the intrinsic group of 58 patients, the antral secretion was sterile or showed non-pathogens in 19, yielded potential pathogens in 26 and pathogens in 13 Among the extrinsic group of 24 cases, the antral secretion showed no micro organisms or non pathogens in 14, potential pathogens in nine and a pathogen in one

Based on the cultural and microscopic criteria we have established, 30 of the 82 patients showed evidence of sinus infection (See Table II) Among the 58 intrinsic cases, 25 had sinus infection and 33 were free from infection Among the 24 extrinsic cases, five had sinus infection and 19 were free from infection

TABLE I

BACTERIOLOGY OF PARANASAL SINUSES IN BRONCHIAL ASTHMA

	Sterile	Non-Pathogens	Potential Pathogens	Pathogens
58 Intrinsic cases	9	10	26	18
24 Extrinsic cases	3	11	9	1
Total—82 Cases	12	21	35	14

TABLE II

PARANASAL SINUS INFECTION IN BRONCHIAL ASTHMA

	Without Sinus Infection	With Sinus Infection
58 Intrinsic cases	33	25
24 Extrinsic cases	19	5
Total—82 Cases	52	30

In summary, infection was present in less than half of the intrinsic group and in about 20 per cent of the extrinsic group The absence of infection in the majority of intrinsic cases is noteworthy because infection is frequently offered as the most probable causative factor in this form of bronchial asthma.

2 *Long Term Bacteriologic Observations of Sinuses in Asthma*

Our study of these asthmatic patients over a three year period permitted us to obtain a long term bacteriological perspective in a number of patients, several of whom had had previous sinus surgery (See Table III) The following are illustrative

Cases 1 and 2 demonstrate that pathogens may be isolated from the sinuses for a brief period of time and then not be recovered for months thereafter These cases strongly suggest that such infections were transient in character Their presence or clearing had no influence on the course of the asthma

Case 3 illustrates the multiplicity of pathogens which may characterize the sinus flora of asthmatics In this patient, Staph aureus A was consistently present over a 10 month period For a short time Pneumococcus Type 10 was found in two cultures two weeks apart and H parainfluenza was isolated on another occasion Then on four successive observations, neither of these two pathogens could be demonstrated

In Case 4, three different pathogens were isolated at different times over a period of 22 months

In Case 5, multiple infection of the sinuses caused by Staph. aureus A and Pneumococcus Type 25 was present for several months Antibiotic therapy rid the sinuses permanently of the staphylococcus, but the pneumococcus persisted Streptococcus hemolyticus then appeared briefly and for three months thereafter only non-pathogens could be found

Case 6 shows that a persistent sinus infection can be caused by the same micro organism over a period of two years, in this instance by Staph aureus A On two separate occasions, once for a period of several months, Streptococcus hemolyticus was also cultured from the sinus secretion

These studies indicate the variety of micro organisms that may inhabit the sinuses in a single case, and that they often may be transient rather than permanent residents This multiplicity suggests a lack of specificity in the relation of the micro organisms isolated to the underlying membrane pathology and to the continuing asthma Variations in the bacterial flora of the sinuses was

TABLE III

LONG TERM BACTERIOLOGIC OBSERVATIONS OF THE PARANASAL SINUSES IN BRONCHIAL ASTHMA

Time in Months

CASES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
1—S R	o	o		x Pneumo 10	x	o	o	o	o		o	o													Transient Infection
2—E M	o	o	o		x Pneumo -o Strep hemolyt.		x Strep virid	x		o	o														Transient Infection
3—V M	x Staph aur A.		x Pneumo 10	x	x H para-infl	x Staph aur A	x	x		x															Multiple Infection
4—W B	o	o	x Pneumococcus	x	x	x		x 8		x		x		x Strep. hemolyt.	x		x Pneumo 11	x	x		x Strep hemolyt.	x			Multiple Infection
5—E F	x Strep viridans		x	x Pneumo 25 Staph aur A.	x	o	o Antibiotics	o		x Pneumo 25		x	x Strep hemolyt.	x		o	o	o							Multiple Infection
6—E L.	x				x x Strep hemolyt.	x	x Staphylococcus aureus x				x A				x		x Strep hemolyt.	x			x			x	Persistent and Transient Infection

x = Pathogens or Potential Pathogens

o = Nonpathogens

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1—S R	o	o		x Pneumo 10	x	o	o	o	o		o	o													Transient Infection
2—E M	o	o	o		x Pneumo Strep. hemolyt.	o	x Strep virid.	x		o	o														Transient Infection
3—V M	x Staph aur A		x Pneumo 10	x	x H para infl.	x Staph	x aur	x A.		x															Multiple Infection
4—W B	o	o	x Pneumococcus	x	x	x		x 8		x		x		x Strep hemolyt	x		x Pneumo	x 11	x		x Strep hemolyt.	x			Multiple Infection
5—E F	x Strep viridans		x	x Pneumo 25 Staph aur A	x	o	o Antibiotics	o		x Pneumo 25		x	x Strep hemolyt	x		o	o	o							Multiple Infection
6—E.L.	x				x x Strep hemolyt.	x	x Staphylococcus x				x aureus A.				x		x Strep	x hemolyt.			x			x	Persistent and Transient Infection

x = Pathogens or Potential Pathogens

o = Nonpathogens

unaccompanied by any change in the asthmatic status Such findings argue strongly in favor of the concept that pathogens isolated from the sinuses of asthmatics are invaders infecting abnormal membranes

3 *Correlation of Sinus Radiology with Bacteriologic Evidence of Infection*

Seventy-one patients had both complete Roentgen and bacteriologic examinations (See Table IV) In 15 cases *with* abnormal sinus membranes, cultures of the sinus washings were sterile or yielded non-pathogens Equally important is the fact that in 18 cases *without* abnormal sinus membranes, cultures of the sinus washings yielded potential or actual pathogens When the cases were divided according to the presence or absence of infection of the sinuses, it was found that of 42 cases with positive X-rays, 18 showed sinus infection and 24 no infection (See Table V) Of 29 cases with negative X-rays, nine had sinus infection and 20 no infection It, therefore, appears that thickened membrane of the

TABLE IV

RADIOLOGIC AND BACTERIOLOGIC FINDINGS OF PARANASAL SINUSES IN BRONCHIAL ASTHMA

Sinus X-ray Findings	Sterile	Non-Pathogens	Potential Pathogens	Pathogens
Negative X-rays 29 Cases	3	8	14	4
Positive X-rays 42 Cases	6	9	20	7
Total—71 Cases	9	17	34	11

sinuses may be observed on roentgenograms in bronchial asthma without evidence of sinus infection and, conversely, sinus infection may be present without thickened membranes.

Our observations however do indicate that sinus infection was more frequent in cases with abnormal membrane findings. This combination of infection and thickened membrane was seen more often in intrinsic asthma than in asthma with detectable allergic factors. We wish to point out that this does not necessarily imply a causal relationship

TABLE X
RADIOLOGIC FINDINGS AND PARANASAL SINUS INFECTION IN BRONCHIAL ASTHMA

Sinus X ray Findings	Without Sinus Infection	With Sinus Infection
Negative X-rays 29 Cases	20	9
Positive X-rays 42 Cases	24	18
Total—71 Cases	44	27

4 *Bacteriology and Micro-pathology of Sinus Membranes*

These observations are offered tentatively, for, as a small group of cases, they serve chiefly to raise questions rather than to provide answers. In our evaluation of the bacteriology of the membranes we have relied entirely upon the blood plate cultures. Broth cultures permit no quantitative estimate of the micro-organisms present, so that information obtained from them may be misleading

TABLE VI
BACTERIOLOGY AND MICRO-PATHOLOGY OF PARANASAL MEMBRANE IN BRONCHIAL ASTHMA
1 Antral Membrane Removed at Operation

Case	Bacteriology		Pathology	
	Pre-operative	Membrane	Micro-organisms	Histo-pathology
1—S A	Sterile	Sterile	None	Infiltration with many eosinophils Edema
2—M K	Pseudomonas aeruginosa many colonies	Sterile	None	Same as Case 1
3—E F	Staphylococcus albus B Few colonies	Staphylococcus albus B Few Colonies	None	Same as Case 1
4—A B	Staphylococcus albus A Few colonies	Staphylococcus albus A Few Colonies	None	Same as Case 1
5—N Z	Pneumococcus 19 Moderate colonies Streptococcus hemolyticus Few colonies	Staphylococcus albus A Few Colonies	Superficial necrosis with cocci Few cocci beneath basement membrane	Same as Case 1
6—D B	M catarrhalis Diphtheroids	Streptococcus viridans Moderate colonies	None	Same as Case 1
7—J H	Streptococcus viridans Staphylococcus aureus A Moderate colonies	Streptococcus non-hemolyticus Moderate colonies	None	Same as Case 1
8—F E	Pneumococcus 19 Many colonies	Pneumococcus 19 Many colonies	Few cocci beneath basement membrane	Same as Case 1

Cultures of entire antral membranes, removed at operation in eight cases, revealed the following (See Table VI) In two cases the membranes were sterile on blood agar plates The membrane of a third case showed only Staphylococcus albus B Two membranes yielded only a few colonies of Staphylococcus albus A The sixth membrane yielded moderate numbers of Streptococcus viridans.

The seventh showed Streptococcus non hemolyticus in similar numbers. The eighth membrane yielded many colonies of Pneumococcus Type 19 In general there was agreement between preoperative cultures of sinus secretion and membrane cultures The single discrepancy was the finding of pathogens in the secretion that were not cultured from the membrane (See Case 5)

TABLE VII
BACTERIOLOGY AND MICRO PATHOLOGY OF PARANASAL SINUS MEMBRANE IN BRONCHIAL ASTHMA
2. Trephine Biopsy of Antral Membrane

Case	Bacteriology		Pathology	
	Pre-trephine	Membrane	Micro-organisms	Histo-pathology
9—M C	Sterile	Sterile	None	Infiltration with many eosinophils Edema
10—T B	Sterile	Sterile	None	Same as Case 9
11—E G	B Proteus many colonies	Staphylococcus albus B	None	Same as Case 9
12—M M	Aerobacter Aerogenes	Aerobacter Aerogenes	None	Same as Case 9
13—C O	Sterile	Staphylococcus aureus A. many colonies	None	Non-specific acute and chronic inflammation
14—K.K.	B Proteus many colonies	B Proteus many colonies	None	Same as Case 13
15—C R.	Streptococcus viridans Moderate colonies	Staphylococcus aureus A many colonies	None	Same as Case 13
16—J.S	K Pneumoniae many colonies	Streptococcus hemolyticus moderate colonies Staphylococcus aureus A. moderate colonies	Occasional cocci in surface exudate Very few within tissue	Same as Case 13

Cultures of membrane biopsies in eight cases, obtained by trephine through the inferior meatus, revealed the following (See Table VII) The membranes in two cases were sterile, in two infection in seven Nine cases manifested no evidence of recurrent polypoid disease or infection Thus the final rhinologic result was unsatisfactory in the majority of our cases despite complete and repeated surgical procedures and careful postoperative care

Of interest, too, was the often paradoxical relationship between the rhinologic status and the effect upon the asthma following radical sinus surgery Three of the six cases with clinical improvement of the asthma, including both cases of actual "cure", showed evidence of return of polypoid disease On the other hand, among the nine cases with good postoperative rhinologic results, only one was observed to have experienced any significant improvement of the asthma following the operative procedures

The results in the second follow-up group without radical antrum surgery were as follows 13 patients had a more favorable course after operation Of these, four experienced a prolonged remission or "cure" of the asthma Seventeen were unimproved or worse

The postoperative rhinologic status was evaluated in 27 of the 30 cases Polypoid regrowth was present in eight cases and gross sinus infection in three Sixteen cases manifested no evidence of recurrent polypoid disease or infection

Comparison of the results of the two follow-up groups shows a greater frequency of favorable effect upon the asthma in the patients who did not have radical antral surgery While it is probable that the severity of the asthma may not have been the same in the two groups of cases, the data do illustrate that improvement of asthma and even apparent "cure" may occur *without* complete removal of presumed bacterial foci A favorable course was observed in a minority of the cases in both groups following operation

DISCUSSION

Our findings in this study emphasize the need for more precise criteria in the diagnosis of sinus disease as foci of infection In vasomotor or allergic patients, the careful differentiation between infected and vasomotor secretion and membrane is of vital importance if proper therapy is to be employed

For over 20 years the effect of sinus infection on the underlying pathologic alterations of the mucous membrane and the relationship of both to the accompanying asthma has been a matter of controversy. On the one hand there has been the point of view that the sinus infection is the primary cause for the membrane changes and asthma mediated through a mechanism of bacterial allergy.[2-4] The edematous, eosinophil infiltrated sinus membrane with micro-organisms described as uniformly present deep in the tissues is offered as objective proof of bacterial allergy. Opposed to this there has been the viewpoint that sinus infection is superimposed upon an already abnormal allergic or vasomotor membrane. Those who hold this opinion have not regarded infection as the cause, either of the membrane pathology or of the accompanying asthma, although the infection may aggravate and alter the course of both.[4,5]

As evidence to support the latter concept we have submitted the following observations: *1.* Absence of infection as judged by our criteria in many instances of sinus disease; *2.* No proof of sinus infection in many cases of intrinsic asthma. *3.* The long term bacteriologic studies which suggested the occurrence of transient and multiple infections of the sinuses in asthma. *4.* The lack of consistent correlation between Roentgen and bacteriologic findings of the sinuses; *5.* The failure to demonstrate significant micro-organisms either on culture or on sections of sinus membranes which showed typical allergic pathologic alterations.

We have made a small series of observations on asthmatic responses to provocative injections of autogenous sinus vaccines. Such symptomatic asthmatic reactions have been offered as evidence of specific bacterial allergy.[3] While we do not include a report on our findings in this paper, they indicated that single positive asthma responses should be interpreted with caution. In our experience the majority of injections failed to induce asthma. These findings will be presented in detail elsewhere.

Extensive membrane disease affecting all sinuses was more common in the intrinsic than in the extrinsic asthma group, as has been previously reported by Weille.[4] This may explain the greater frequency of infection in the intrinsic cases. The proponents of the bacterial allergy theory consider these findings as supporting their concept. We consider the findings previously cited, which indicate that the sinus infection is not a causative but a superimposed factor in this disease, to be more convincing and conclusive.

At this point we should like to indicate our acceptance of the bacterial allergy hypothesis as illustrated by the initiation of a systemic disease by an upper respiratory infection. The classical example of this, of course, is the relationship of acute hemolytic streptococcal infection of the pharynx and rheumatic fever. In the course of this study, for instance, we have seen paranasal sinus infections precipitate the development of erythema nodosum and periarteritis nodosa.

In children the sequence of asthma following acute upper respiratory infections is not uncommon, although the precise mechanism remains obscure. In such instances, as in some cases of our own series with multiple pathogens, one must envision so broad a spectrum of bacterial and/or viral reactivity as to raise the question whether the reaction could be one of specific allergy.

There is a difference of opinion concerning the effectiveness of radical sinus surgery on bronchial asthma.[9, 10, 11, 12] In our small series, improvement of asthma was twice as frequent when surgery did not include removal of antral membrane. The severity of asthma in the two patient groups may not have been comparable, and so no conclusion is offered as regards the superiority of one type of surgery over the other; however, the results are of interest in that improvement of asthma, even apparent arrest of the disease, occurred without eradication of the presumed focus of bacterial allergy.

The data gathered, we believe, also adds support to the view that the therapeutic approach to sinus disease in asthma should be conservative. The extent of treatment should be determined by the local findings rather than by the concept of bacterial allergy. The use of sinus irrigations in conjunction with antibiotic therapy, systematically and locally, is the initial treatment of choice. When postnasal discharge, even of non-infected secretion, aggravates cough or asthma, or non-infected polypoid sinus disease causes obstruction, conservative surgery may be required. Only when there is evidence of persistent infection, associated either with local symptoms or with intractable asthma, do we feel justified in contemplating the use of radical sinus surgery.

SUMMARY AND CONCLUSION

1. Eighty-two patients with bronchial asthma had complete sinus investigations to determine the role of sinus infection in their disease. The study included allergic, rhinologic and sinus X ray examinations, together with microscopic and bacteriologic studies of nasal and sinus secretions. Precise criteria of infection were emphasized.

2 Among 58 cases of intrinsic asthma, 25 had sinus infection and 33 were free from infection Among 24 extrinsic cases five had sinus infection, and 19 were free from infection Although sinus infection was more frequent in the intrinsic group, it was present in less than half of such cases in which infection is usually considered as a causative factor

3 Bacteriologic observations of sinus secretion made repeatedly, in some cases over many months, revealed the occurrence of transient and multiple infections. These findings suggest that the microorganisms isolated cause infection on a previously abnormal membrane as a result of vasomotor or allergic influences rather than act as etiologic agents responsible for the altered sinus membrane

4 In the correlation of sinus roentgenograms with bacteriologic findings, of 42 cases with positive X rays, 24 showed sinus infection while 18 were free from infection. Of 29 cases with negative X rays, nine showed sinus infection while 20 were free from infection. Although sinus infection was more frequently associated with abnormal sinus membrane, such membrane disease may occur without infection, and infection may occur without membrane disease in asthmatic patients.

5 Bacteriologic and micro-pathologic study of antral membrane was done in 16 cases of intrinsic asthma In seven cases membranes showed an allergic reaction with many eosinophils, edema and thickening of basement membrane, although cultures yielded no growth or only non pathogens None of these showed micro-organisms on tissue sections. Four membranes with the same pathology cultured small to moderate numbers of potential pathogens. On tissue sections micro-organisms were seen localized near the surface in one membrane. Pathogens were obtained from a single allergic membrane and a few micro-organisms were seen beneath the basement membrane. Four membranes showed non-specific acute and chronic inflammation and yielded pathogens. In one of these membranes

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micro organisms were visible on section but were located superficially

6 The findings of the membrane study indicated that hyperplastic allergic sinus membrane may occur in the absence of infection Sinus infection when present appears to be located chiefly near the surface of the membrane

7 A follow-up study of one to 14 years after sinus surgery in 61 asthmatic deals with two groups of cases, with and without radical antrum operation Definite improvement in asthma occurred twice as often in the group without removal of antral membrane, although only a minority of patients were benefited in either group Arrest of asthma may occur even though antral membrane is not removed Significant improvement of asthma after radical sinus surgery may occur despite the regrowth of polypoid tissue, and paradoxically, there may be no improvement of asthma despite an excellent postoperative rhinologic status

8 The findings offered in this study appear to warrant the conclusion that sinus infection, as a rule, is not a primary cause of asthma but rather a complication superimposed on altered sinus membrane

9 The management of sinus disease should include at first conservative measures and later such surgery as dictated by local naso sinal abnormalities and by persistent infection The decision to employ radical sinus procedures should be determined by these factors rather than by the concept of bacterial allergy alone

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OTITIC COMPLICATIONS WITH ANTIBIOTIC RESISTANT BACTERIA[*][†]

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In the treatment of infections of the ear and mastoid there have been three distinct eras within the experience of our generation of otologists the long era prior to the advent of chemotherapy and antibiotics, in which otitic infections and their complications were commonplace and temporal bone surgery for relief of these infections were daily occurrences, the second, or the antibiotic era, in which practically all infections of the ear and mastoid were controlled with the proper antibiotic, and the third in which infections of the ear and adjacent structures are not being controlled by antibiotics, and complications such as deafness, lateral sinus thrombosis, meningitis and brain abscess are being seen frequently because of the development of strains of the common pathogenic organisms which have become resistant to the various antibiotics.

The time has passed when the otologist and his referring physicians, the practitioner and pediatrician, can relax complacently behind a large dose of penicillin or other so called miracle drugs when treating a patient with acute or chronic otitis media In a survey of the use of antibiotics in otology one is led to the conclusion that too much reliance has been placed on them, and that many of the glowing reports of cure of mastoiditis with penicillin and other antibiotics has led physicians in general to the practices of omitting the guidance of the otologist in evaluating the ear pathology

Complications of otitic disease are being seen and reported in ever increasing numbers, and the reasons for such reports are as follows

1 Bacterial resistance to antibiotics due to their prolonged or indiscriminate usage "Shotgun" therapy with antibiotics helps to develop resistant organisms

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[*] Read at the meeting of the Eastern Section American Laryngological, Rhinological and Otological Society Inc Philadelphia Pa January 7 1955

[†] From the Otolaryngology Service Graduate Hospital of the University of Pennsylvania, Philadelphia, Pa

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2 The development of mutations of bacteria which easily acquire resistance to antibiotics.

3 Widespread use of antibiotics topically as lozenges or sprays so that resistant strains or allergic reactions develop

4 Inadequate dosage of antibiotics at the onset of an infection

5 Use of the specific antibiotic too late in an infection after the complication has developed

6 Use of the wrong antibiotic at the start of the infection and later shifting to the proper one.

7 Masking of continued infection or complications by antibiotics.

8 "Superinfection," a term which is applied to fresh complicating infections arising during antibiotic therapy

Different bacterial species and strains possess varied inherent susceptibilities to drugs. In addition to the well known resistance of the gram negative organisms to sulfonamides and penicillin, marked differences occur between drug susceptibilities of different strains of the same gram positive organism.

Since staphylococcus adapts readily to changes in environment, each drug used extensively to eliminate staphylococcal infection eventually becomes ineffective Treatment with penicillin, streptomycin, chlortetracycline, chloramphenicol, oxytetracycline or erythromycin is often unsuccessful. Strains resistant to bacitracin or neomycin are less common.

The insensitive strains become established among persons treated with or exposed to antibacterial agents. The staphylococcus exists in the nares and on the skin and is easily disseminated by sneezing or coughing Because of this rapid dissemination healthy persons soon become carriers of resistant strains. It has been established that 60 per cent of the strains of staphylococci are now resistant to penicillin, and the incidence is increasing rapidly Prior to the introduction of penicillin in 1942 approximately 12 per cent of the strains of staphylococci isolated from patients were found to be naturally resistant to the drug Over 50 per cent of the strains isolated in the latter part of 1949 and early 1950 were observed to be highly resistant to penicillin. This demonstration of penicilli resistance *in vitro* has been correlated with the therapeutic failure and coincides with the experience of others

Davison suggested a few years ago that penicillin levels in 194 had to be 15 times higher than in 1946 in order to inhibit growt of 80 per cent of gram positive cocci in nasal exudates

Romansky pointed out before this Society a few years ago that the gram positive cocci were not only developing resistance to penicillin, but also to aureomycin, chloromycetin and terramycin

The response of bacteria to various drugs is a complex of different factors, and the inner mechanism varies with species and with drugs so that no one explanation of drug resistance can cover more than a few individual cases

Resistance can be developed both *in vitro* and *in vivo* by contact of the bacterium with sublethal concentrations of drug through several successive generations Development of resistance is a gradual process, and the final degree of resistance is often dependent upon the concentration of drug employed Resistance to high concentrations of drugs can be developed by repeated exposure to small doses

The maximum resistance capable of being developed varies greatly with different organisms, and staphylococcus strains have been shown to develop a higher degree of resistance than streptococci or pneumococci

The rapidity with which resistance is acquired also varies greatly with different organisms and different drugs Once resistance has been acquired it is often, but by no means always, a fairly permanent characteristic of the strain and may survive numerous transfers in the absence of the drug

An organism rendered resistant to one drug is often found to have acquired at the same time cross resistance to chemically related drugs, and sometimes also to chemically unrelated drugs

Micro-organisms appear to be capable of developing resistance to the majority of drugs which are employed clinically In view of the cross resistance referred to between different groups of drugs it is obviously important that the clinician should have information as to which groups of drugs may be usefully tried in infections with resistant strains. There is some clinical evidence that synergism occurs in certain combinations of antibiotics against resistant bacteria.

From the clinical point of view the production of the enzyme penicillinase by resistant strains is quite important, and in *vitro* tests of penicillin sensitivity should take penicillinase into consideration Penicillinase an enzyme that destroys penicillin is produced by a wide variety of bacteria There is not a direct relationship between the amount of penicillinase produced by an organism and its susceptibility to penicillin The rapidity of production is more important than the potential of producing large amounts.

With the large number of antibiotic drugs now available, accurate and rapid diagnosis of the organism causing the infection and its sensitivity to the various antibiotics is essential to the proper treatment of the patient With the use of discs of the antibiotics in three dilutions placed on blood agar plates with the cultured organisms accurate results can be obtained in 24 hours informing the clinician as to the causative organism and its relative resistance or degree of sensitivity to each antibiotic.

In the antibiotic era of the past 15 years the literature has been filled with miraculous cures of otogenic complications by use of chemotherapy and antimicrobial agents, and as a result there has developed among the laity and physicians alike a false sense of security so that the otologist who suggests surgery of the ear or mastoid before the patient is moribund is viewed with suspicion. It is a well known fact that every purulent otitis carries with it a number of potential complications and the early recognition and treatment of these complications is all important Many cases of fatality have been reported due to masking of the classical signs and symptoms of intracranial complication by antibiotics, and Cirillo in England states that chemotherapeutic temporizing tends to delay life saving surgical procedures in cases of serious intracranial complications.

A case in point was reported by von Christierson The patient was treated for otitis media for two weeks with sulfadiazine. The drum had healed, and the patient seemed well. Severe headache suddenly developed, with convulsions and vomiting and within a short time the patient died An autopsy showed a healed drum, necrotic petrositis and adjacent localized meningitis and massive cerebellar abscess

The following cases which illustrate the type of otitic complications seen with antibiotic resistant bacteria were a few of those treated on the Otolaryngologic Service at The Graduate Hospital, Philadelphia, during the past year

Case No 1 A 6 year old white female was admitted in a semicomatose state with a history of an upper respiratory infection of two weeks' duration She had developed an acute otitis media on the right side after 10 days illness She improved clinically on penicillin therapy, but after the cessation of treatment her earache returned A myringotomy was performed with release of purulent secretion Again she was treated with penicillin and improved clinically, however, headache nausea and vomiting followed, and she was admitted to a local hospital where a spinal tap revealed cloudy fluid, and the culture indicated a pneumococcus. The dosage of penicillin was increased, but no improvement was noted and after two days the patient went into a coma and was transferred to The Graduate Hospital for further evaluation

The physical examination at the time of admission to the hospital revealed a semi comatose, toxic dehydrated white female child with a positive Kernig's sign, Brudzinski sign and some opisthotonus The temperature was 98, pulse 60 and respirations 20 Otoscopic examination revealed purulent secretions in the right canal pulsating from a small posterior attic perforation There was an unsustained nystagmus to the right and the fundiscopic examination was normal She had a purulent pharyngitis and bilateral rhonchi in the upper lung fields The spinal fluid contained 148 cells predominantly lymphocytes, and the chemistry was normal Her blood picture showed an anemia and a leucocytosis of 16 000 with 80 percent neutrophiles X ray examination revealed a right acute mastoiditis with evidence of cell breakdown The skull films were negative and the chest plate revealed a tracheobronchitis

It was believed that she had a subdural abscess with extension into the posterior fossa and she was given 1,000,000 units of aqueous penicillin every two hours, 2 5 grams of sodium sulfadiazine intravenously, 500 c c. of whole blood and fluids Under general anesthesia a simple mastoidectomy through a post auricular incision was performed Immediately after the cortex was removed a copious amount of purulent secretion exuded through the opening The lateral sinus was already exposed by the disease and was thrombotic This was incised and some thrombotic debri removed until there was a free flow of blood from above and below the incision

Since this open perisinus abscess exposed the dura of the posterior fossa and the latter was covered with granulation tissue the cerebellum was probed for abscess but none was located The temporal fossa dura showed no pathology, so consequently no further attempt to uncover an abscess was made After the lateral sinus and mastoid cavity were packed the skin incision was allowed to remain open to facilitate any future manipulation

Culture of the material from the abscess showed beta hemolytic streptococcus and hemolytic and non hemolytic staphylococcus aureus which were sensitive to achromycin 150 mg of that antibiotic was given intravenously every six hours, along with the penicillin and sulfadiazine

On the third post-operative day due to a bout of respiratory depression the cerebellum was again probed through the mastoid area, but again no abscess was located The next five days of convalescence showed no apparent improvement and on the eighth post-operative day papilledema was noted A rotary nystagmus to the right and nucal rigidity reappeared. The pulse dropped to 88

Because of these signs a right temporo-parietal and occipital trephine were performed the latter releasing 20 c. c. of thin purulent material from the cerebellum A culture of this revealed the same organisms as the perisinus abscess. After this procedure the patient improved rapidly and was discharged within two weeks One month later the only neurologic sign present was a minimal loss of coordination in her right hand and foot.

This is a case of acute otitis, which was due to the beta hemolytic streptococcus and the hemolytic staphylococcus aureus, which were both resistant to penicillin, the antibiotic with which she was being treated when her complications developed Despite the fact that these organisms were found to be sensitive to achromycin, I feel certain that she would not have recovered without complete surgical intervention

Case No 8 A 16-year-old white male was admitted with the chief complaint of earache on the left side, with discharge from that ear for one month He had been successfully treated with antibiotics for left ear ache two years prior to this

Two weeks before admission he developed headache and his earache became more severe. He had multiple injections of penicillin without improvement. Four days before admission he developed a stiff neck and his temperature and headache increased until two days before admission when he became nauseated vomited several times and complained of weakness.

Physical examination revealed a semi-comatose dehydrated white male pulse 70 respiration 24 and a temperature of 104 Otoscopic examination revealed purulent secretions in the left canal exuding from a posterior marginal perforation The right ear was normal Fundoscopic examination was normal but there was noted an unsustained vertical nystagmus and a fleeting horizontal nystagmus to the right. The mastoid tip on the left was tender to palpation

Neurologic examination revealed a positive Kernig, Brudzinski and Babinski sign The rest of the physical examination was essentially negative except for some fading hemorrhagic spots in the skin of the abdomen.

A lumbar puncture revealed a pressure of 305 mm. water The cell count of the spinal fluid was 2800 with 90 percent polymorphonuclears and 85 mg percent of sugar The culture was sterile Blood culture was negative, but a culture of the secretion from the ear revealed a beta hemolytic streptococcus. It was believed he had a cerebellar abscess secondary to an acute mastoiditis

He was given 2 000 000 units of aqueous penicillin every two hours two grams of Benemid daily 5 grams of sodium sulfadiazine intravenously and 3 000 c.c. of fluid After 24 hours of intensive antibiotic and fluid replacement therapy a simple mastoidectomy under local an esthesia was performed through a post auricular incision The contents of the mastoid cavity consisted of necrotic bone and a small cholesteatoma in the antrum which had penetrated the tegmen and produced granulation tissue on the dura of the middle fossa. This area was incised with a return of clear cerebrospinal fluid

The lateral sinus was exposed, and about one ounce of pus was released from around the sinus The posterior fossa dura was exposed and it appeared normal except for minimal injection of the vessels and therefore, was not incised The lateral sinus was incised a thrombus removed and after a free flow of blood the sinus was packed above and below the incision

The mastoid cavity was packed and allowed to remain open for future manipulation if necessary The culture from the lateral sinus showed hemolytic streptococci and bacillus proteus which were found to be resistant to all antibiotics

The patient responded well immediately after surgery The next morning his headache and temperature subsided, and he was more active, but 19 hours after surgery he had difficulty with his speech developed a cough and his temperature fell rapidly to subnormal Within the hour he turned cyanotic and a tracheotomy was performed in bed He was given intracardiac adrenalin and central nervous system stimulants. The neurosurgical department was consulted and thought his symptoms were on a central basis due to edema and a generalized encephalitis and arachnoiditis The otolaryngology staff felt that the posterior fossa should be incised and probed for abscess formation This was done under aseptic technique at the bedside but revealed no purulent material

During the next week the patient improved gradually, but still maintained a temperature between 100 102 Reculture of the mastoid showed bacillus proteus, again not sensitive to any of the antibiotics

On the fourth post operative day he had a generalized convulsion. He was again re-evaluated by the Neurosurgical Department, but no procedure was advised at that time His post-operative course for the next 10 days was relatively favorable His temperature and pulse had returned to normal, the spinal tap was clear and showed only seven cells the mastoid cavity was open, but no purulent secretions were present. The antibiotics had been discontinued the packs were all out and extubation started On the 14th post operative day he again had a respiratory depression and succumbed 36 hours later

At autopsy a left infratentorial abscess was found with bacillus proteus the predominate organism resistant to all antibiotics

Case No 3 A 68-year old white male with a history of left sided earache and otorrhea of three days duration Two days prior to admission he had a short period of unconsciousness Examination revealed a comatose elderly male with left sided purulent ear discharge and mastoid tenderness Kernig and Brudzinski's signs were positive His temperature was 105 4 rectally and the spinal fluid showed 330 cells, and the culture was sterile A culture of the ear discharge revealed hemolytic staphylococcus aureus and paracolon, and both organisms were resistant to all antibiotics He was treated with large doses of sulfadiazine, penicillin and streptomycin Two days after admission a simple mastoidectomy was done and a purulent meninigitis found Culture from the mastoid cavity showed the same organisms as the ear discharge, and they were found to be resistant to all antibiotics His post operative course was stormy but he was discharged six weeks after admission in good health

An interesting feature of these three cases is that they all had acute and not chronic otitis media, with rapidly developing serious complications that were not controlled by antibiotics because of resistant bacteria. They all illustrate well the need for early and complete surgical intervention in otitic complications.

CONCLUSIONS

1 Bacterial resistance to antibiotics is on the increase

2 Complications of otitic infection due to resistant organisms are being observed more frequently

3 Sensitivity cultures in cases of otitic infection to determine the proper antibiotic is imperative

4 Complete surgical removal of infected tissue and abscess drainage is as important as in the pre antibiotic era

5 It is the duty of the otologist to keep the medical profession and the public aware of the changing concepts in medical and surgical care of the ear

BRONCHOESOPHAGOLOGY COURSE

The next Bronchoesophagology Course to be given by the University of Illinois College of Medicine is scheduled for the period October 24 to November 5, 1955, under the direction of Dr Paul H. Holinger

Interested registrants will please write directly to the Department of Otolaryngology, University of Illinois College of Medicine, 1853 West Polk Street, Chicago 12, Illinois.

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The following Post-Graduate Courses to be given in this Department during the current year

Post-Graduate Course in Broncho-Esophagology, June 13-24, 1955, October 17 - 28, 1955

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These courses are all to be given in the Department of Laryngology and Broncho-esophagology, Temple University Hospital and School of Medicine, under the direction of Dr Chevalier L Jackson and Dr Charles M Norris The tuition fee for each course is $250 00 Further information and application blanks can be obtained from Dr Chevalier L Jackson, 3401 N Broad Street, Philadelphia 40, Pennsylvania

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KENFIELD SCHOLARSHIP

The American Hearing Society announces March 1 as opening date for competition for the 1955 Kenfield Memorial Scholarship, an award made annually to a prospective teacher of lipreading Application blanks may be obtained by writing to the society's national headquarters, 817 14th St, N W, Washington 5, D C

Deadline for returning completed applications is May 1 They are to be mailed to Mrs Dorothy J Cornett, 4310 S W 14th St, Coral Gables 34, Fla

Winner of the Kenfield Memorial award is entitled to take a teacher training course in lipreading from any school or university [illegible] United States acceptable to the Teachers Committee [illegible] scholarship is to be used within one year from the

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SURGICAL APPROACH FOR SO CALLED GLOMUS JUGULARE TUMORS OF THE MIDDLE EAR[*][†]

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In the last few years the otologic literature has contained numerous reports of a primary vascular tumor peculiar to the tympanic cavity and now generally referred to as glomus jugulare tumor of the middle ear Seven of these tumors have been seen by the author and his associate Eugene Derlacki, and six have been operated In two cases a new "hypotympanotomy" surgical approach was utilized to gain access to the tumor without sacrificing the hearing

The glomus jugulare is a tiny structure normally occurring in the adventitia of the dome of the jugular bulb immediately below the hypotympanum and close to the ramus tympanicus of the glossopharyngeal nerve Measuring scarcely 0 5 mm. broad by 0.25 mm thick this minute ovoid structure was first described in 1941 by Guild[1] who observed that it usually consists of a single glomus or mass of vessels of capillary or precapillary size with numerous epitheloid cells between Occasionally, instead of a single glomus, two or more smaller bodies are present, sometimes one or all are in the canal that transmits the *ramus tympanicus* of the glosso-pharyngeal nerve through the floor of the middle ear, and in one case the body occurred along the course of this nerve over the cochlear promontory Because histologic structure and nerve

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Read at the meeting of the Middle Section, American Laryngological Rhinological and Otological Society Inc., Detroit Mich., January 4 1955

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Since Rosenwasser's naming of this tumor a number of excellent articles on glomus jugulare tumors of the midd ear have appeared, including a report of eight new cases fro Columbia University by Lattes and Waltner[4] in 1949, and 11 new cases by Lester Brown[5] in 1953 From the numerous published reports, and our own experience, certain characteristics that seem peculiar to these tumors can be enumerated

1 There exists a definite predilection for angioendotheliomas to occur in the tympanic cavity, often arising from the hypotympanum but sometimes directly from the dome of the jugular bulb Their histologic structure and point of origin strongly suggest that they arise from the glomus jugulare structure of Guild, as proposed by Rosenwasser

2 They occur in young and middle-aged adults more often than in the later years, when carcinoma is more prevalent I have encountered no cases reported in children

3 They are generally quite slow growing but are locally invasive In a few instances they have been frankly malignant with a much more rapid invasive growth, regional and distant metastases, and fatal termination from intracranial extension

4 The symptoms begin with an early conductive hearing loss, often with a pulsating tinnitus synchronous with the pulse As the tumor invades and extends through the tympanic membrane otorrhea frequently occurs Profuse bleeding spontaneous or more often following instrumentation and biopsy, becomes a prominent and alarming symptom As the tumor invades the surrounding bone, facial paresis, vertigo, profound or total inner ear deafness, headache, and finally involvement of the nerves of the jugular foramen appear

5 Otoscopic examination in the earliest stage is characteristic a sharply defined reddened or bluish mass in the tympanic cavity behind the intact tympanic membrane In one of our cases this had been misinterpreted elsewhere as a Schwartze's sign from a vascular otosclerotic focus, but utilizing the magnifying speculum and keeping in mind the early appearance of these tumors there should be no confusion

Later when the tumor has protruded through the tympanic membrane into the meatus one will see an ordinary appearing polyp, often with more or less purulent discharge around it The profuse bleeding, controlled only by packing the meatus when the polyp is removed, may offer the first clue of the correct diagnosis Unless the growth is far advanced with extensive erosion of surrounding bone the X-ray picture is not helpful The definitive diagnosis is made by histologic examination revealing an angioendothelioma, which because of its site of origin may be classified as a glomus jugulare tumor of the middle ear

6 Lester Brown[9] has described a "pulsation sign" that he believes is particularly characteristic of these tumors With a Bruening Siegel speculum that fits tightly into the meatus one observes the tumor while increasing the pressure in the meatus with the attached rubber bulb As the pressure is slowly increased the tumor is seen to pulsate, sometimes almost violently, or if already pulsating the pulsations are seen to increase Then as the air pressure is further increased the tumor will blanch and the pulsations cease, only to recur as the pressure is slowly released, reaching a maximum and then diminishing again as the intrameatal pressure returns to normal We have recently tried this test exactly as de-

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scribed by Brown, and we have observed pulsations of some of the tumors through the magnifying speculum, that disappeared on carotid pressure

7 Most authors[6] do not regard these tumors as radio-sensitive, although a good many of the reported cases were irradiated preceding or following surgical removal[4 5 7]

8 Surgical removal by means of a radical mastoidectomy to expose the tumor in the tympanic cavity has been the treatment generally recommended, except for far advanced growths which by X-ray had destroyed much of the petrosa and were considered inoperable

In the majority of reported cases surgical removal has resulted in freedom from recurrence, but most of the cases had been followed for less than five years Lattes and Waltner[4] do report one case without recurrence 17 years after surgical removal

Our own experience with these interesting neoplasms began several years ago when we were not yet attuned to the early clinical picture of the glomus jugulare tumor This was a middle-aged woman complaining of an annoying pulsating tinnitus in the right ear Behind a normal tympanic membrane a sharply defined reddened mass was seen to occupy the anterior inferior third of the tympanic cavity, with visible pulsations that disappeared along with the tinnitus on carotid artery pressure An aneurysmal enlargement of the carotid artery, where it passes just in front of the tympanic cavity, was suspected, but much more likely this patient had had an early glomus tumor which we failed to recognize

Of the six cases that we have operated (see Table), the first two were moderately advanced tumors that filled the tympanic cavity, one protruded through the tympanic membrane into the meatus, both had resulted in total or profound nerve deafness with vertigo in one, and at operation both were found to arise from the dome of the jugular bulb with erosion of the floor of the hypotympanum In both a similar surgical technique was employed for removal

Because of the profuse bleeding that occurred with the

SIX OPERATED GLOMUS JUGULARE TUMORS

No	Sex	Age	Symptoms	Duration of	Otoscopic	Hearing and Caloric Tests	Surgical Procedure	Operative Findings	Result
1	male	35	Progressive Deafness Left ear	1½ yrs.	Red Tumor behind M T	Dead labyrinth	Ligation Int. Jug Vein Radical mastoid and Exposure Jug bulb	Tumor arose from Jugular bulb	4 yrs. 10 mos. No known recurrence
2	male	27	Sudden Deafness Left ear	3 mos.	Red Tumor protruding through lower edge of M T	Profound Nerve Deafness Neg Caloric	Ligation Int. Jug Vein and External carotid A sigmoid sinus packed OH Rad Mastoid & exposure jugular bulb	Tumor arose from Jugular bulb	No recurrence 2 years
3	female	46	None	—	Red Tumor behind M T	Mild con ductive loss	Hypotympanotomy	Tumor arose from floor of hypotympanum	No recurrence 1½ years
4	female	25	Fullness & Pulsation Left ear	1 yr	Red Tumor behind M T	Mild con ductive loss	Hypotympanotomy	Tumor arose from floor of hypotympanum	No recurrence 11 months
5	female	45	Progressive Deafness R ear & Vertigo	1 2 yrs.	Atresia of Meatus	Severe con ductive and high tone perceptive loss	Radical Mastoid 9 months later revision	Tumor filled middle ear attic mastoid external meatus and eustachian tube	Died 1 year after first operation
6	female	34	Progressive Deafness Left ear & Otorrhea	7 yrs.	Polyp filled external meatus	Severe con ductive loss	Endaural radical	Tumor arose from hypotympanum filled external meatus middle ear, attic and antrum	No recurrence 3 months

preliminary biopsy and our suspicion that they might arise from the jugular bulb, the internal jugular vein was first ligated, and in addition the external carotid artery was tied off, and the sigmoid sinus packed off in one By means of an endaural radical mastoidectomy the tumor mass filling the tympanic cavity was exposed with profuse bleeding each time the tumor was disturbed, controlled only by iodoform gauze packs

The hypotympanum and jugular bulb were then exposed by resecting the entire tympanic bone forming the anterior, inferior and posterior osseous meatal wall until the ascending portion of the carotid artery in its bony canal, the facial nerve emerging from the stylomastoid foramen and the jugular bulb with the attached tumor protruding upward into the tympanic cavity lay fully exposed This was done without any attempt to mobilize or remove any of the tumor, thus avoiding the profuse bleeding that obscured the surgical field whenever the tumor itself was manipulated

As Weille and Lane[8] so aptly put it "the patient was removed from the tumor rather than the tumor from the patient" Only when the tumor lay fully exposed was it rapidly dissected away from the dome of the jugular bulb, using a small periosteal elevator, with constant suction for the profuse bleeding When the bleeding had subsided with the help of an iodoform gauze pack, the point of origin on the jugular bulb was cauterized in the first case, using the topical sclerosing solution of Mohs[9] Although care was taken not to apply this chemical to the exposed facial nerve, complete facial paralysis followed the operation In the second case the base of the tumor on the jugular bulb was fulgurated by electrocoagulation, and facial paresis did not result Both patients have dry, well epidermized cavities, the first nearly five years after operation with no known recurrence (the patient was last seen two years ago, and in the absence of symptoms has not returned), the second with no evidence of recurrence after two years, however, the first patient had a solid jugular bulb at operation, probably filled with tumor, and a dead labyrinth possibly invaded by tumors, so a permanent cure is doubtful

The complete facial paralysis has partially recovered—perhaps 30 per cent. The second patient had a glossopharyngeal nerve anesthesia of the pharynx before operation, suggesting tumor in the jugular foramen This anesthesia has recovered only in part, so again we cannot be certain of a cure

The two most recent patients that have come to us with this condition also had moderately advanced tumors Case 5 in our series had a more malignant appearing tumor on histologic examination than the other cases, and nine months after an apparently complete removal by radical mastoidectomy there was a recurrence in the Eustachian tube with a large metastatic cervical gland A second extensive operation to resect the osseous Eustachian tube was nevertheless followed by a fatal termination from evident intracranial extension three months later, one year after the first operation and only two or three years after the first symptom

Case 6 had a moderately advanced tumor that filled the tympanic cavity, the entire external auditory meatus to the tragus, and the attic and antrum, and appeared to originate from the hypotympanum This was removed by the usual endaural radical mastoidectomy three months ago, too soon of course, to draw any conclusions concerning recurrence

The two of our patients who presented the earliest tumors were Cases 3 and 4 in our operated series The first, a woman of 46, was referred by Dr Von Leden who, in a routine otolaryngologic examination, had observed a localized red mass in the posterior half of the tympanic cavity behind a normal tympanic membrane She denied any ear symptoms but showed a mild conductive hearing loss. In an effort to preserve the normal sound conducting apparatus and good hearing the following technique first worked out on the cadaver, was employed to expose the tympanic cavity widely via the hypotympanum

1 The usual Lempert endaural incision as modified by the author and his associates[10] so as to preserve the skin that forms the curve of the posterior meatal wall

2 A supplementary incision through the skin of the infe rior and anterior meatal wall along the outer edge of the osseous meatus

3 Elevation of the skin of the anterior, inferior and posterior osseous meatal wall as a tube to the sulcus tympanicus, thus exposing almost the entire extent of the tympanic bone

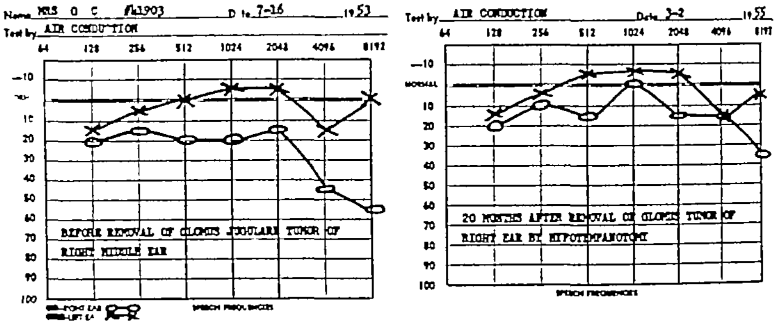


Fig 1 Audiograms on Case 3

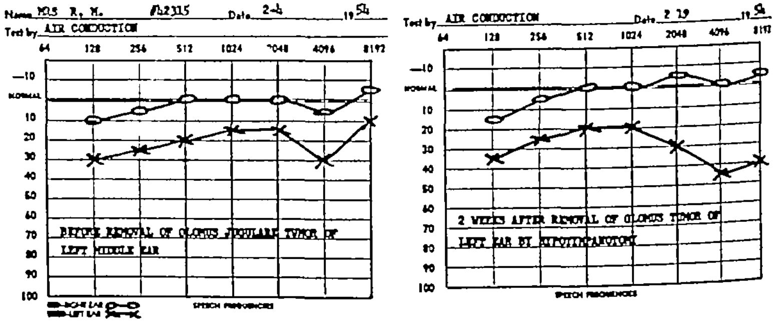


Fig 2 Audiograms on Case 4

4 With a dental driven burr the anterior and inferior osseous meatal wall thinned down so as to widen and enlarge downward and anteriorly the osseous meatus The position of the facial nerve in the posterior meatal wall where it emerges from the stylomastoid foramen must be kept in mind By removing the floor of the meatus anterior to, but not beyond, a vertical line through the posterior edge of the sulcus tympanicus the facial nerve is safely avoided

5 Elevation of the annulus tympanicus from its sulcus anteriorly, inferiorly and posteriorly, as first described by Lempert[11] and subsequently utilized by Rosen[12] for biopsy of glomus jugulare tumors This permits the pars tensa to be folded upwards upon itself, exposing all but the upper anterior portion of the tympanic cavity

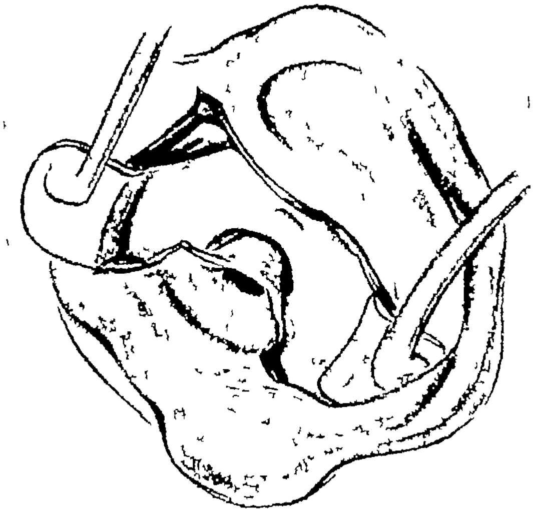


Fig 1 Exposure by Endaural Incision.

6 Resection of the bony sulcus tympanicus inferiorly so as to expose fully the hypotympanum and tumor within it.

7 The tumor in Case 3 fully exposed by this hypotympanotomy with minimal bleeding, was observed to occupy the posterior three-fourths of the tympanic cavity with its base in the hypotympanum and two lobes, one enveloping the incudostapedial joint. The latter was carefully teased away from the stapes to which it was not at all adherent, and both

lobes were then rapidly dissected from the promontory to which they were moderately adherent, and from the floor of the hypotympanum to which they were more adherent, with suction for the profuse bleeding A millimeter sized opening toward the jugular bulb poured venous blood each time an iodoform gauze pack was removed, until it was controlled by electrocoagulation Careful inspection of the tympanic cavity

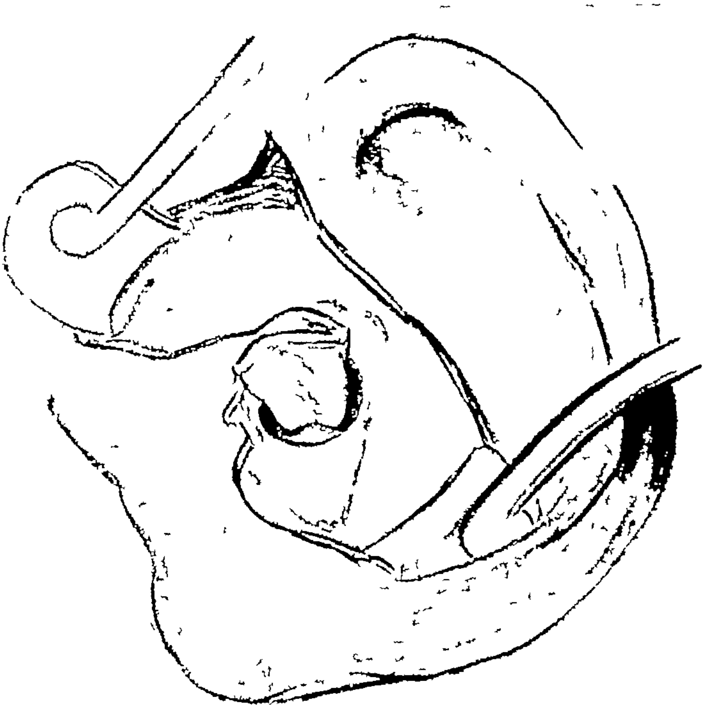


Fig 4 Incision extended around floor of osseus meatus permitting the skin of the osseus meatus to be elevated upward exposing floor and anterior meatal wall

with magnification when all bleeding had been controlled revealed no visible remnants of tumor

8 The tympanic membrane and meatal skin were folded back into position with split thickness skin grafts to line the enlarged meatus where it was not covered by its own skin

Five weeks after operation the ear was dry and healed, and the hearing slightly improved over the pre-operative test Six months after operation, however a small perforation appeared along the inferior edge of the tympanic membrane, which is responding favorably to the Lynn Derlacki[14] closure technique

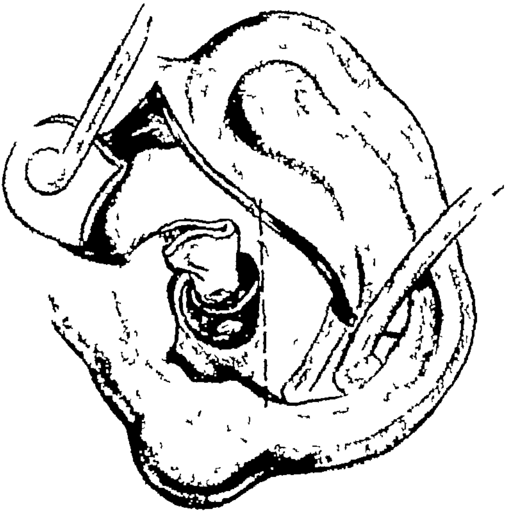


Fig 5 Bone removal from floor and anterior wall of the osseus meatus approaching the dome of the jugular bulb Sulcus tympanicus intact. Note that bone removal is anterior to vertical line drawn through posterior meatal wall so as to avoid the facial nerve

Our fourth operated case when first seen had almost an identical early tumor that occupied the inferior two-thirds of the tympanic cavity, however, she delayed operation three months, during which time the tumor grew appreciably and became adherent to the lower portion of the tympanic membrane The same hypotympanotomy technique was carried out as in the preceding case, except that the lower involved edge of the tympanic membrane was removed, a split thickness skin graft being placed against the lower edge of the remaining tympanic membrane and lining the enlarged osseous meatus Three weeks after operation the ear was healing rapidly, and the hearing was improving when the patient returned to her home in Venezuela

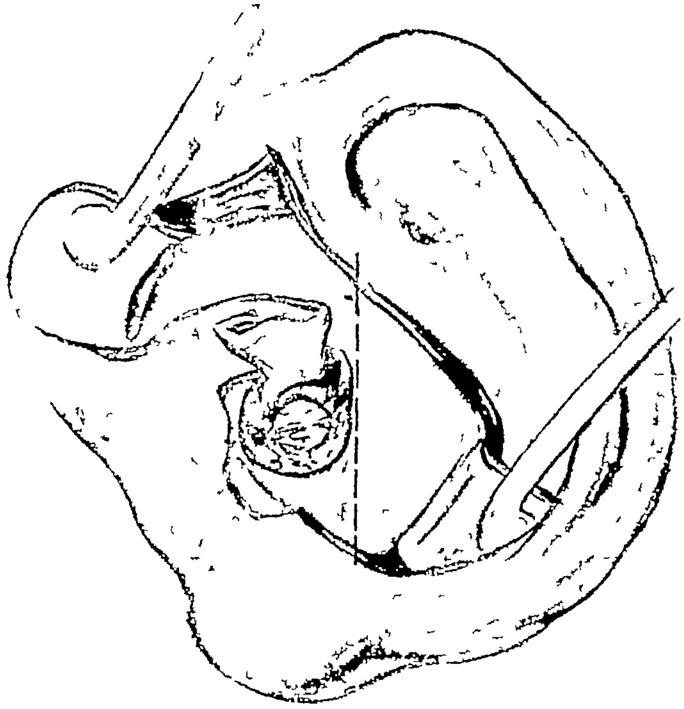


Fig 6 Sulcus tympanicus has been resected exposing tumor in hypotympanum

CONCLUSIONS

1 A primary tumor of the tympanic cavity having the histologic structure of angioendothelioma and arising usually from the hypotympanum or jugular bulb could very well arise from the glomus jugularis structure of Guild, and fall into the classification of glomus jugulare tumor of the middle ear

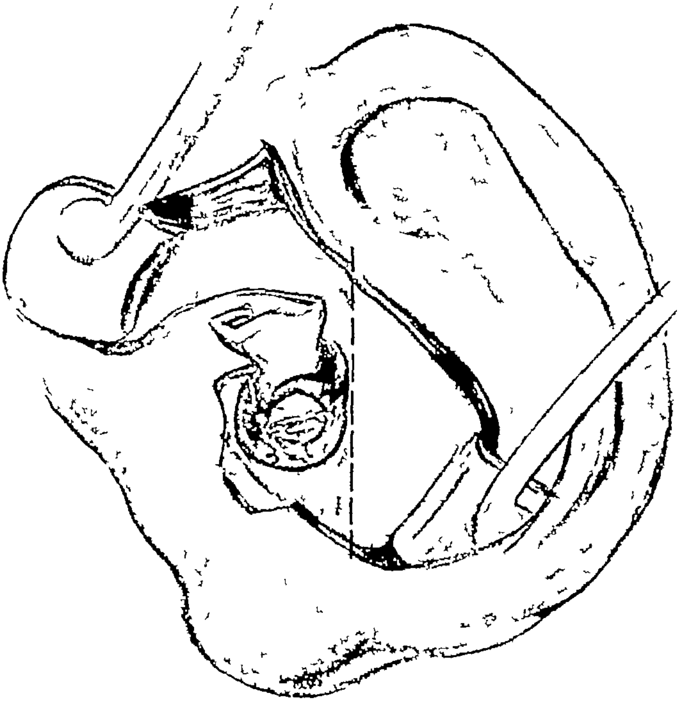
2 These tumors are usually slow growing but locally invasive and are not radio-sensitive Early surgical removal is advisable before the hearing is seriously impaired and important adjacent structures have become involved

3 For larger tumors radical mastoidectomy with exposure of the hypotympanum, and if necessary the jugular bulb, will permit the tumor to be removed rapidly *en masse* with a minimum of blood loss The patient should be typed, and blood on hand for transfusion, but by 'removing the patient from the tumor" leaving the latter *in situ* until fully exposed the blood loss has not necessitated a transfusion in any of the author's cases

4 The technique of hypotympanotomy is described for removal of early glomus jugulare tumors confined to the hypotympanum and tympanic cavity, so as to gain adequate exposure of the tumor without sacrificing the hearing This approach to the tympanic cavity has not been described before, although Rosen[12] suggested that "in cases where the tumor arises from the promontory it might be possible to excise the entire tumor" by simply elevating the tympanic membrane, while Brown[14] mentions that "it may be possible to remove a small hypotympanic tumor through an incision in the floor of the external auditory canal, whereby the lower half of the drum membrane could be turned up and the tympanum exposed"

Brown notes that with this technique "poor visibility would be the greatest deterrent." With this statement I would agree, for the profuse bleeding attending removal of these tumors requires sufficient exposure to see all of the tumor clearly before removal is begun, and to introduce a good size suction tube, and, if necessary, electrocoagulation, to control the bleeding, both of which would be exceedingly difficult through the normal size meatus.

Naturally the preservation of hearing should not be at the risk of incomplete removal of tumor If the surgeon finds that hypotympanotomy does not fully and adequately expose the tumor he should not hesitate to proceed with the radical mastoidectomy through the same endaural incision edge of the tympanic membrane was removed, a split thickness skin graft being placed against the lower edge of the remaining tympanic membrane and lining the enlarged osseous meatus. Three weeks after operation the ear was healing rapidly, and the hearing was improving when the patient returned to her home in Venezuela.



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SUBACUTE THYROIDITIS *†

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The nature of this paper is to call to the attention of the otolaryngologist the manifestations of subacute thyroiditis, and to note how the impact of the newer methods of treatment has affected its management. Although the general literature contains many substantial studies on the varied facets of thyroiditis, the otolaryngological literature is singularly free of references to this disease

Subacute thyroiditis is a clinical entity apparently being seen with increasing frequency in laryngological practice With the exception of some of the congenital anomalies of the thyroid, the otolaryngologist generally regards the diseases of the thyroid gland to be in the province of the internist and the surgeon, however, because of the nature of his symptoms, the patient with subacute thyroiditis often consults the otolaryngologist first, and unless he is acquainted with the disease the diagnosis will be missed

Subacute, granulomatous or giant cell thyroiditis (de Quervain's disease) is currently regarded as a non suppurative, non bacterial inflammation of the thyroid gland It is a self-limited disease, sudden in onset, often following an upper respiratory infection, and lasting several weeks to several months, it affects females more frequently than males and usually occurs in the fourth or fifth decades

The disease varies in severity, manifesting itself often as a mild painful swelling of the thyroid gland, and at times as a severe illness characterized by high fever and prostration The cardinal symptom, as described by the patient, is a sore throat and pain on swallowing, the pain is often referred to

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the angle of the mandible and to one or both ears, and the dysphagia may be pronounced during the early part of the disease

The thyroid gland is tense, diffusely enlarged, and one lobe or the other, or the isthmus, is the seat of the pronounced tenderness on palpation The tenderness may migrate, or may extend from one lobe to the entire gland All too often in laryngology, routine palpation of the neck is confined to the cervical, post cervical and laryngeal regions, and the thyroid and supraclavicular areas are neglected The examination of the pharynx and larynx is negative, although the patient may feel that the initial pain is localized in the pharynx It has been stated that the patient often cannot tell the difference between a sore throat and a sore thyroid gland

The constitutional reaction is variable In some cases the patient complains of some transitory generalized aching and fever, often described as an upper respiratory infection, in the severe cases the symptoms are considerable and may last for several weeks The initial febrile period usually lasts from five to 12 days

There is an elevation of the white blood count, and the sedimentation rate is significantly lengthened The pulse rate is higher than the temperature would indicate The basal metabolic rate and plasma cholesterol level is within normal limits The serum protein-bound iodine is normal, indicating a normal secretory activity of the gland, although this figure has been found elevated during the acute phase There is a very low uptake by the thyroid gland of radioactive iodine The uptake of iodine rapidly returns to normal after remission of the disease

An occasional patient presents symptoms of tachycardia, sweating, and nervousness which suggest hyperthyroidism In these cases the I^{131} uptake is especially useful, because it is always decreased in cases of thyroiditis A few of the patients may develop definite myxedema two or three months after the acute stage, and require replacement therapy with thyroid Recently Sheets[1] reported an unusual case of thyrotoxicosis four months after complete recovery from acute thyroiditis

The course of the thyroiditis is irregular, in the mild type the symptoms may disappear spontaneously in a few days, in the severe type, the course may be prolonged even after X-ray and other therapy The dramatic response to hormonal therapy not only shortens the progress of the disease but also assists in the differential diagnosis

The microscopic sections of cases of subacute thyroiditis show a picture characterized by cellular infiltration, connective tissue proliferation and giant cell tubercles

The etiology is unknown Despite the occasional report of some improvement following the use of antibiotics and the removal of foci of infection, the disease is probably not bacterial Bacterial cultures of these glands are negative Thyroiditis has been considered to be caused by bacterial toxins originating in the pharynx, based on the presumption that the disease appeared to follow an acute upper respiratory infection Frazier and Harrison[2] and others have suggested a virus etiology, Lindsay and Dailey[3] mention the possibility that the lesions seen on histological section might be reactions of hypersensitivity

The treatment of subacute thyroiditis has been especially successful since the advent of Cortisone and ACTH Many articles in the recent literature report the prompt and dramatic response to the administration of these agents Clark, Nelsen, and Raiman[4] found that a single daily dose of 25 mg of Cortisone for 12 - 14 days resulted in a relief of symptoms in 24 hours, and the gland was restored to normal size and consistency within two months

Crile and Schneider[5] administered 100 mg of Cortisone daily with prompt improvement in the patient's symptoms and size of the thyroid gland Lasser[6] used injections of Cortisone acetate 100 mg daily in four divided doses, slowly decreasing the dosage and extending the period of treatment by the oral route for a total of 26 days Cutler[7] successfully used 40 units of ACTH gel daily for four days, and 20 units on the fifth day in one case, and a larger initial dose (80 u) on a second case It has been advised to continue Cortisone treatment until the sedimentation rate reaches a normal level

Subacute thyroiditis can be successfully managed by X-ray therapy or the use of thiouracil[8] Crile and Rumsey[9] used 100-150 r daily for one week with splendid symptomatic relief and decrease in the size of the thyroid gland A course of external radiation of 500-1500 r is generally considered to be of great value in bringing about subjective and objective improvement

In Crispell's[10] experience many cases recur after discontinuing Cortisone or ACTH He advises a trial with X-ray therapy first and uses Cortisone only for symptomatic relief He has found that X-ray therapy may give satisfying results in 24-48 hours In one of his cases of thyroiditis using Cortisone the patient became worse and the gland became more tense It became evident that the process was a suppurative thyroiditis and antibiotics and surgical drainage were necessary

In the acute case, bed rest, together with the use of local heat treatment and the appropriate analgesic is necessary The sulfonamides and antibiotics are of no value

Because it is a self limited disease, treated effectively by medical means, thyroidectomy is not indicated Surgical intervention has been done when the persistent pain suggested a hemorrhage into an adenoma, when a neoplasm was suspected or from symptoms resulting from thyroid pressure. Therapeutic trial with ACTH or Cortisone or needle biopsy should clear any doubt in diagnosis

The following case reports illustrate the varying degree of severity of subacute thyroiditis

Mr O H age 27 consulted me regarding a persistent sore throat of ten days' duration He complained of painful swallowing and earache on the right side A colleague had been unable to explain the cause of his discomfort Examination of the ears, nose, throat and larynx was negative Palpation of the thyroid gland showed a very tender tense, slightly swollen right lateral lobe He was afebrile, the sedimentation rate, blood count and Wassermann tests were normal He was given 40 u ACTH gel for three successive days with complete remission of the inflammatory process and relief of his symptoms

Mrs H G age 35 complained of sore throat and pain on swallowing of three weeks duration She had been under the care of another physician for 'ulcers of the throat' and was dissatisfied with her progress Examination showed a normal appearing upper respiratory tract. She presented on palpation an exquisitely tender diffuse enlargement of the thyroid gland She complained of generalized aching and malaise and her oral temperature was persistently elevated 1° above normal The sedimentation rate was 25 mm. in one hour and the white count was elevated to 16 400 the serology and urine analysis was negative hematocrit was 44 per cent, and chest X-ray report was negative

Her response to ACTH gel (40 u daily for four days 20 u daily for six days) was prompt on the second day of treatment she noted a subsidence of her symptoms the gland became less tender and swollen and she proceeded to a satisfactory recovery

Mrs F C complained of painful throat symptoms for several weeks before the enlarged tender thyroid gland was recognized as the source of her trouble Inasmuch as she was seen before the days of hormonal therapy she was treated by X ray therapy without relief of her pain Her course became quite stormy with severe constitutional symptoms Because of her unsatisfactory progress and the extent of thyroid gland involvement, she was admitted to the University of Virginia Hospital seven weeks later

Examination on admission showed a well nourished and developed 48-year-old woman Her chief complaints were sore throat difficulty in swallowing and tender swelling over the front lower portion of her neck. The positive findings were slight obesity carious teeth and 2+ enlargement of the thyroid gland Her temperature 101 F BP 130/75 and sedimentation rate 35 mm in one hour Her urine was normal in all respects the blood picture was as follows Hb 11 5 gm R B C 3 6 Hematocrit 35 per cent W.B C 10 400 The X ray of her chest was negative the tuberculin test 1 100 000 negative 10 000+ The I^{131} uptake was 2 5 per cent in 24 hours a low figure consistent with the diagnosis of thyroiditis She was given further X ray therapy The process gradually subsided and there has been no recurrence to date

The differentiation between subacute thyroiditis and the forms of chronic thyroiditis from a clinical point of view is not difficult It is currently customary to divide thyroiditis into three types *1* Subacute thyroiditis, *2* Struma fibrosa of Reidel, and *3* Struma lymphomatosa or lymphocytic thyroiditis of Hashimoto

Reidel's struma is a painless hard, non-toxic enlargement of the thyroid gland The etiology is unknown There is no tenderness or fever The symptoms of tracheal pressure predominate paralysis of the recurrent laryngeal nerve occurs The important feature of Reidel s thyroiditis is the hard enlargement of the gland and the fibrosing inflammatory process of one or both lobes extending to involve the neighboring structures in an adherent mass The differential diagnosis from cancer of the thyroid is often difficult The histological picture is that of a dense diffuse plasma cell and lymphocytic infiltration and fibrosis The treatment is surgical

Struma Lymphomatosa of Hashimoto and Lymphocytic thyroiditis is a painless, symmetrical progressive enlargement of the thyroid gland The gland is firm and irregular, and may simulate an adenomatous goitre without hyperthyroidism The basal metabolic rate is variable and the sedimentation rate is within normal limits The disease occurs in women beyond the age of 40 but may be seen in younger girls Gribetz[11] et al, reported six cases of non-toxic goitres in girls who were found to have lymphocytic thyroiditis, their diagnosis was made by surgical exploration and by biopsies obtained with the aid of the Silverman needle The radioactive iodine uptake in Hashimoto's thyroiditis is 43-62 per cent of the tracer dose, the serum protein-bound iodine concentration is not consistent and may be normal

The pathological section shows a dense infiltration of the gland with lymphocytes and formation of lymph follicles with germinal centers Crile differentiated Hashimoto's struma from lymphocytic thyroiditis by the absence of acidophilic degeneration of the epithelium

The treatment of Hashimoto's disease is surgery for those exceptional cases with symptoms of tracheal pressure X-ray therapy, or the administration of U S P thyroid will successfully control the thyroid enlargement In those rare cases of unusual enlargement of the thyroid gland resulting from lymphocytic thyroiditis, producing the superior vena caval syndrome, as reported by Sholl and Black,[12] sugery is imperative

COMMENT

Crile[13-14] has written that there has been a progressive increase in the incidence of subacute thyroiditis, due perhaps to better recognition He and Rumsey classify subacute thyroiditis into two types *1* The acute fulminating type, and *2* a chronic type, in which the fever, pain, tenderness, and systemic symptoms are minimal In laryngological practice, in my experience, the diagnosis of mild to moderately severe cases is often overlooked, these cases are treated under the guise of a variety of ear and throat conditions Indeed a tonsillectomy has been reported to have been performed because of a supposed chronic sore throat

There is general acceptance of the clinical concept that the three varieties of thyroiditis mentioned are separate and distinct entities. There is no agreement among pathologists on this score. Baker[13] has reviewed the views of those who contend that Reidel's and Hashimoto's struma are separate pathological entities, and those who believe the two conditions are different manifestations of the same process He reported two cases presenting the microscopic findings of both diseases combined

Needle biopsy as an aid in diagnosis in thyroiditis has been advocated by Crile in the doubtful cases In subacute thyroiditis the diagnosis is most often clinically evident, and a prompt response to Cortisone or X-ray therapy will confirm the impression In those cases in which carcinoma is suspected, surgical exploration and biopsy is preferable. In lymphocytic thyroiditis the needle biopsy will find its greatest usefulness

As pointed out by Perry[14] the mechanism of the action of Cortisone and ACTH on the thyroid function is uncertain By radioactive iodine uptake and protein bound iodine studies it has been shown that a depression of thyroid function is produced by ACTH and Cortisone This factor plus the general suppression of the inflammatory reaction is supposed to bring about the response to this form of therapy

CONCLUSION

Attention is called to the importance of subacute thyroiditis in clinical otolaryngology and the successful use of Cortisone, ACTH, and X-ray therapy in its management. The otolaryngologist should be aware of the characteristics of subacute thyroiditis, sore throat, difficulty in swallowing a tender tense enlargement of the thyroid gland, an increased erythrocyte sedimentation rate, a marked depression of the uptake of radioiodine by the thyroid gland, and a normal or increased concentration of protein-bound iodine in the serum

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The 1955-1956 Home Study Courses in the basic sciences related to ophthalmology and otolaryngology, offered as a part of the educational program of the American Academy of Ophthalmology and Otolaryngology, will begin on September 1, and continue for a period of ten months Detailed information and application forms can be secured from Dr William L Benedict, the executive secretary-treasurer of the Academy, 100 First Avenue Building, Rochester, Minnesota Registrations should be completed before August 15

LYMPHOBLASTOMA IN OTOLARYNGOLOGY *

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The purpose of this paper is to consider the factors involved in the diagnosis and handling of patients with lymphoblastoma by the otolaryngologist The term in this paper refers to lymphosarcoma and Hodgkin's disease Since specific treatment is chiefly in the realm of the roentgenologist and internist, only the general factors in its treatment will be considered

Since so much attention has been given to metastatic cancer of the cervical lymph nodes in recent years, it is at first surprising to find that there are relatively so few articles in the literature dealing with primary cancer, however, this is easier to understand when one becomes aware of the extreme diversity of its characteristics, its almost 100 per cent rate of fatality, its relatively infrequent occurrence and the fact that so little progress has been made in its treatment since Hodgkin[1] first described one form of it in 1832

Few clinicians have an opportunity to see a large number of cases from onset to termination Most private practition ers see a few cases and a few institutions see a relatively large number, but the overall experience in the disease is not nearly so great as it is in most other forms of cancer

A review of the medical literature for the past 25 years indicates that the extranodal local lesions are relatively rare

New and Childrey[2] reported 32 cases of lymphosarcoma of the tonsil and pharynx that had been diagnosed at the Mayo Clinic These constituted 14 55 per cent of 220 cases of cancer in this region

Sugarbaker and Craver[3] reported the results of a study of

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196 cases of lymphosarcoma with biopsy In one-third the primary disease arose in the region of the head The majority of these were in the tonsil or nasopharynx

Catlin[4] reported that 40 per cent of his cases of lymphosarcoma of the head and neck involved the tonsil

A list of reports of one or two cases of extranodal lesions in the field of the otolaryngologist follows

Lymphosarcoma of the tonsil was reported by Hirst,[5] two cases, Morwitz[6] in a three-year-old child, and Young and Price[7] bilateral involvement in a 69-year-old diabetic

Noyer[8] reported its presence in the left pharyngeal wall of a seven-year-old boy This tumor was resistant to Roentgen therapy

Involvement of the mouth was reported by Christiansen[9] in a child who died eight weeks after onset The tumor involved the mandible and right maxilla, and had protruded from the mouth after filling it

Darlington and Leftkowitz[10] reported the death seven weeks after first symptoms of a seven and a half-year-old child with involvement of the upper jaw

Penhale's[11] case died seven months after first involvement of the right mandible, which produced numbness of the lower lip

In Fanale and McCauley's[12] case there was involvement of the soft palate with associated involvement of the cervical nodes

Freedman,[13] of the hard palate He found only one other case of primary involvement of the hard palate

Johnson, Stenstrom and Waldron,[14] multiple lesions involving the left lower jaw, right cheek, floor of mouth and the left side of the hard palate

Hecht,[15] the left upper jaw became involved after involvement of the cervical lymph nodes

Involvement of the maxillary antrum was reported by

New,[16] whose case was alive and well 12 years after internal and external radiation

Sugarbaker and Craver[3] mentioned one case of involvement of the antrum

Harper's[17] case originated in the left ethmoid sinus

Arons[18] reported that of his own 60 cases of cancer of the larynx one was lymphosarcoma In a review of the literature he found that 5 per cent of all malignancies of the larynx were lymphosarcoma

Miller, Dominquez and McCall[19] reported a case with double primary malignant tumors of the larynx One, a squamous cell carcinoma of the right vocal cord, the other a Hodgkin's sarcoma of the right ventricle

Schlemenson and Caceres[20] reported a case of generalized lymphosarcoma with localization in the larynx There was a concomitant lymphatic leukemia They found four reports of lymphosarcoma of the larynx in the literature

Cooke[21] reported hoarseness from an ulcerated nodule on the left vocal cord as the first symptom of Hodkin's disease Microscopically it was found to be infiltrated by the disease. The cervical and axillary lymph nodes became involved later

Linn[22] reported a case of hoarseness from pressure of mediastinal nodes involved by Hodgkin's.

Mannino[23] reported a case of lymphosarcoma of the parotid gland seen and operated upon at the surgical clinic of the University of Palermo Sugarbaker and Craver[3] referred to one such case.

Oppikofer[24] reported infiltration of the right mastoid by extension from an involved cervical node.

Wrong[25] reported involvement of the scalp of a 12-year-old boy by Hodgkin's disease. He was well four years later

Bickel[26] found a tumor of the esophagus 28 cm from the teeth which proved to be Hodgkin's disease

Shebesta[27] reported a case of gangrene of the face produced by lymphosarcoma

In 59 per cent of the cases reported by Sugarbaker and Craver[3] the primary lymph node involvement was in the neck Since a study of the lymph nodes of the body in general indicates that those of the neck constitute about 15 per cent, this may suggest that the etiology is in some way influenced by the anatomical location of the nodes This is especially true, since the cervical nodes are most exposed to the external environment

The lymph node involvement is most inconsistent in all respects, and there is a wide variety of circumstances associated with the involvement One patient may notice a large supraclavicular node, while taking a shower, as first evidence of the disease In another a number of discrete nodes extending throughout any of the several chains may be enlarged Another may have one or two small, firm palpable submental nodes, while still another has a single enlarged node that appears suddenly and incompletely subsides There may be recurrences of this before one becomes suspicious of the presence of lymphoblastoma The lymphadenopathy may or may not be associated with fatigue, loss of weight, backache, fever or sore throat

Certain adults tend to have relative enlargement of the lymph nodes of the body without ever developing any evidence of associated serious disease It may at times be advisable to remove one or more of these nodes for microscopic examination The almost universal lymphadenopathy of moderate degree in children associated with upper respiratory infection needs no further comment

While the blood picture in lymphoblastoma is usually within normal limits, it may be confused with mononucleosis, and it is at times advisable to remove a node for biopsy from a patient who has a history of mononucleosis The author has recently removed an enlarged superior deep cervical node from a 21-year-old girl who had mononucleosis several years ago, and for the past year had had recurring sore throats with associated swelling of the node Her plan to live in Germany forced the decision to remove it It was negative

The decision as to whether to remove a node for biopsy may be difficult, however, if one who has gained experience from examining large numbers of normal and abnormal necks is suspicious for the presence of cancer, biopsy is justified

When biopsy is done it is advisable to obtain as much tissue for the pathologist as is consistent with good judgment

Loseke and Craver[28] recommend aspiration biopsy in certain cases when the nodes are associated with important structures This was diagnostically successful in 56 per cent of 25 cases on which it was used as the first method In the author's opinion use of the method is quite limited

The pathological diagnosis of this disease is no less difficult than the clinical evaluation Even pathologists of wide experience and superior ability and reputation have difficulty at times In some cases this may be due to the fact that diagnostic features are not present in the tissue presented, but it appears that pathologists may vary in the amount of evidence they must have before making a diagnosis A pathological diagnosis of "inflammatory involvement" or "lymphoid hyperplasia" is not uncommon when a lymph node has been removed from a patient who later is found to have lymphoblastoma This is often an unpleasant situation, especially when the clinical evidence is strongly suggestive of the disease.

Heinrich and Judd[29] studied the records of 100 consecutive cases in which biopsy was performed on the lymph nodes and found positive results in 78 per cent of the cervical nodes, 60 per cent of the axillary and 33 per cent of the inguinal

A pathological diagnosis of metastatic squamous cell carcinoma Grade 4, or transitional cell carcinoma, may be made on a node from a patient who never develops a demonstrable primary tumor These patients may follow a rather typical course of lymphoblastoma

The possibility of confusion between these two conditions by the pathologist has been referred to in separate articles by DeJardins[30] and Craver[31]

The author has seen several patients in whom this situation appeared to exist, but it could not be confirmed In personal communications with pathologists, some have expressed the opinion that the similarity between the two conditions may be sufficient to allow for confusion while others have disagreed Jennings[32] states that the situation does arise from time to time, and that the lymph node imprint method of determining cell type has been useful

With few exceptions, lymphoblastoma will respond dramatically to Roentgen therapy, and this may be of considerable value in diagnosis, especially in involvement of the mediastinal nodes It is unusual for any other tumor to respond so promptly and completely, however, Roentgen therapy as a diagnostic test should be used only in specially selected cases, and after all other diagnostic measures have failed to produce confirmatory evidence

When a pathologist reports an enlarged lymph node as non-malignant, and the clinician is satisfied with the clinical picture, the patient may be reassured with little reservation, however, if the clinical appearance of the node is suggestive of malignancy and there are other unexplainable clinical features, one should not be too reassuring

The clinician may recognize immeasurable evidence of the disease based entirely on experience Consequently, a clinical diagnosis of lymphoblastoma will often prove correct in spite of negative pathological reports

The manifestations and general course of the disease cannot be predicted in any patient Some will follow a rapidly declining course terminating in death in a matter of months or a year or two Others may live 20 or 30 years Craver[31] considers early diagnosis and treatment valuable in its course. In a few cases it appears that the disease has been present for many months or even years before it is suspected

The following cases are reported briefly in an effort to illustrate some of the points made in the foregoing discussion

Case 1 A 60 year old man presented an ulcerated tumor of the right tonsil with enlarged cervical lymph nodes on the right A small biopsy removed in the office was reported as lymphosarcoma Following irradiation the cervical node enlargement was much reduced in size but death occurred within a year from progression of the cancer

Case 2 A colored man age 43, was seen first on February 19, 1953 There was a history of swelling of upper left jaw for one month following a tooth extraction Improvement of symptoms had followed several injections of penicillin but considerable pain had remained Roentgenograms which had been taken 10 days previously showed thickened membrane of the left antrum with evidence of soft tissue swelling overlying the antrum (See Fig 1)

On February 24 the antrum was opened through the canine fossa and moderate swelling of the mucous membrane noted A moderate amount of granulation tissue was present. Drainage was instituted and tissue removed for microscopic examination This was reported as chronic inflammatory reaction in soft tissue and granulation tissue formation. The swelling and discomfort remained beyond the usual postoperative period so on March 31st, five weeks later the tumor measuring 2.5 cm. was removed through an external incision on the cheek. Microscopic examination of this tissue revealed lymphosarcoma.

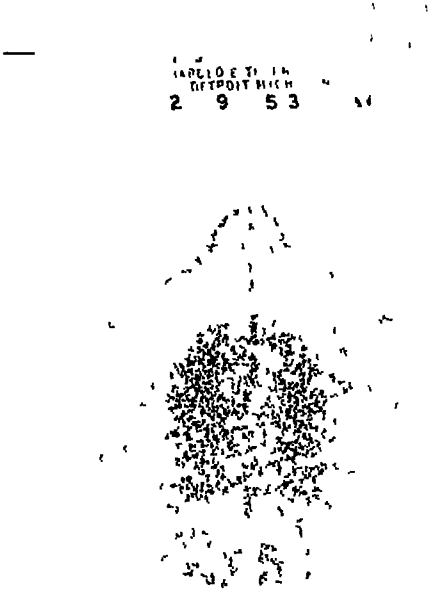

Fig 1. Thickened membrane of the left antrum and soft tissue swelling over the antrum.

Response to irradiation was prompt and complete.

On May 8 moderate enlargement of a left supra-clavicular lymph node was noted This responded promptly to irradiation also

On June 20 marked localized swelling occurred in the midfrontal region. This too, responded to irradiation

October 5 1954 Roentgenograms of the sinuses showed essentially normal findings, and the patient was free of symptoms (see Fig 2)

Fig 2 Normal appearance of left antrum

Case 3 A white woman age 56 developed tenderness over the left lower jaw and discharge of pus and sequestration of a spicule of bone from the left lower molar region three months after extraction of teeth Four months later external swelling developed over the angle of the left jaw When first seen two months later biopsy of a left supra-clavicular lymph node showed Hodgkin's disease The patient died three years later

Case 4 A white male age 29, complained of elevation of temperature in the evening and considerable itching of the skin Biopsy of a left supra clavicular node revealed Hodgkin's disease Death occurred two years later

In Cases 3 and 4 and similar cases, diagnosis is not especially difficult because an obviously abnormal node was present when first seen and diagnosis by the pathologist was prompt.

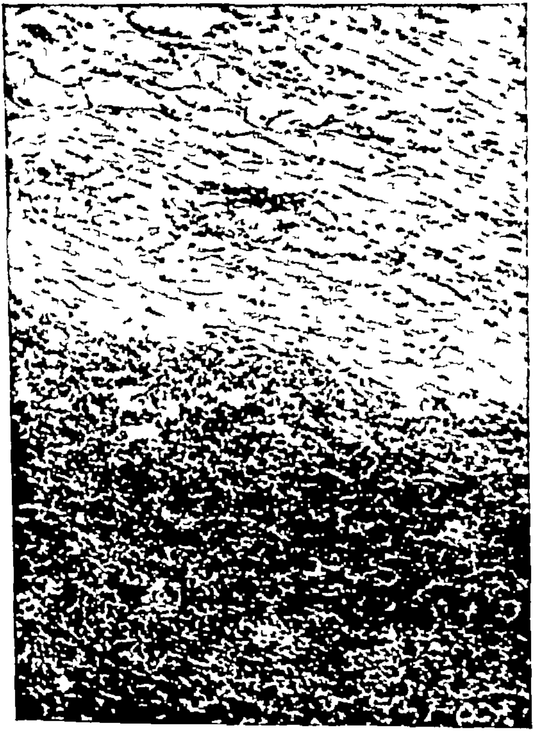

Fig 3 Lymphosarcoma (x 00)

Case 5 A white man, age 49 developed marked enlargement of one of the superior deep cervical nodes on the right in February, 1952 This subsided considerably but not completely and recurred two months later The enlargement subsided moderately again, and then recurred about two months later when first seen At this time it was about 3 cm in diameter

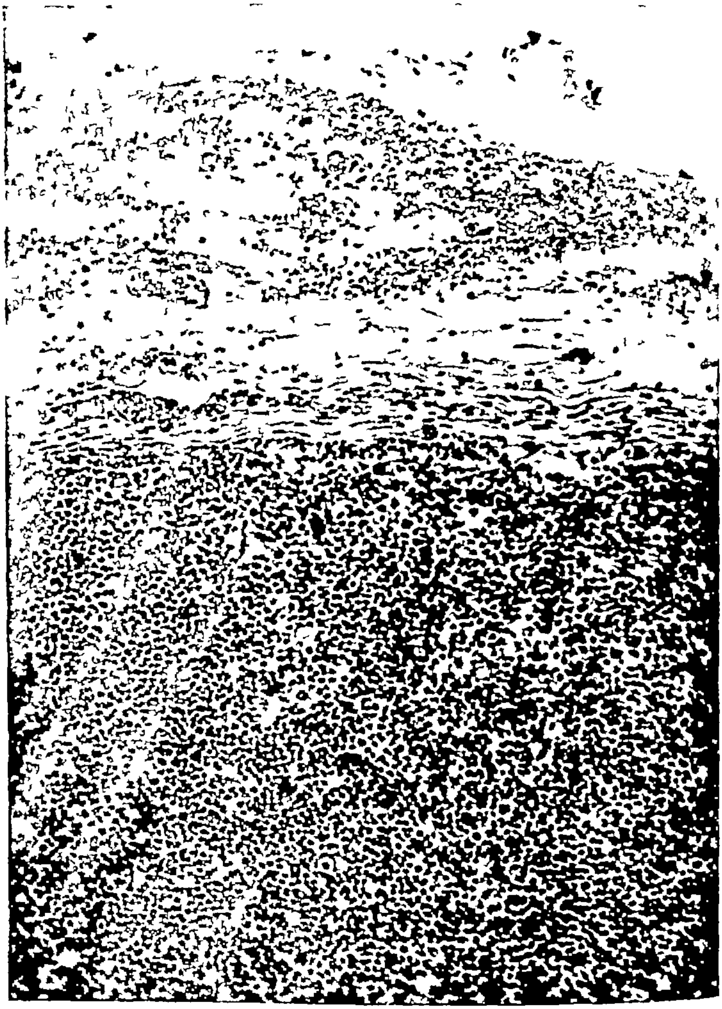

Fig 4 Lymphosarcoma (× 200)

Four days later it had decreased to about 2 cm in diameter after injection of penicillin, however, since it failed to decrease in size further, it was removed for biopsy on September 23, 1952 Microscopic diagnosis was lymphoblastoma reticulum cell type Since only one node was involved, Roentgen therapy was deferred. Two months later swelling in the region of the scar suggested recurrence so Roentgen therapy was carried out.

Two years later there is no evidence of the disease.

Case 6 A white woman age 49 had developed enlargement of several discrete nodes on the posterior border of the left sternomastoid muscle in November 1942 Tissue removed by needle biopsy at that time had not shown neoplasm so the condition was not thought to be important.

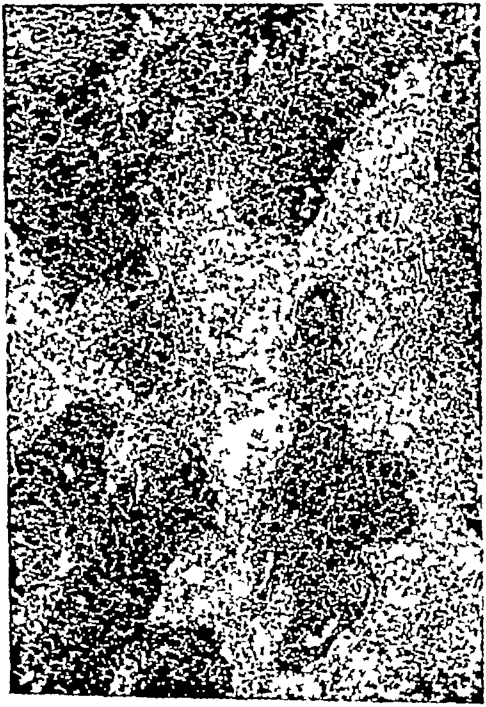

Fig 5 Giant follicular hyperplasia (x 175)

In April 1943 five months later when first seen the most suitable lymph node was removed for biopsy The report of the microscopic examination was lymphoid hyperplasia Following Roentgen therapy the remaining nodes subsided promptly

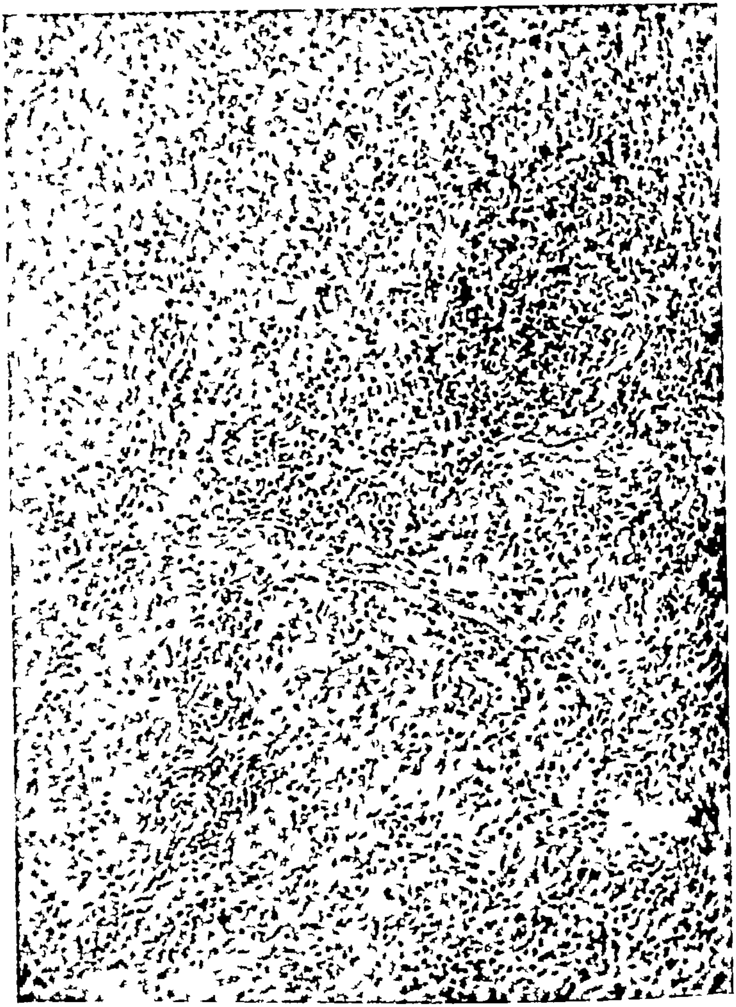

Fig 6 Metastatic Carcinoma Grade 4 (Transitional or Lymphoepithelioma Type) (x 200)

Two months later a left supra-clavicular node became enlarged and this responded to Roentgen therapy also Later node involvement became more general and the patient died

The clinical picture was so typical that in spite of the inability to con firm the diagnosis microscopically it was felt that treatment was justified In retrospect the importance of having microscopic proof is clearer since without it embarrassing situations may arise. On the other hand however recent review of the original slide indicates enough evidence to make a diagnosis of lymphosarcoma (see Fig 3),

Case 7 A white woman was seen first on September 16 1953 There was a history of weakness backache and recurring sore throat of two months duration There were five discrete lymph nodes about 1 3 cm in diameter on the posterior border of the right sternomastoid muscle Two days later all five of these nodes were removed and a presumptive diagnosis of lymphoblastoma of lymphosarcoma type was made but could not be confirmed.

Although she developed no other large superficial nodes she developed a severe cough. Roentgenograms of the chest were negative so bronchoscopy was carried out on December 8 There was evidence of a mediastinal mass noted

The patient was never free of symptoms, but a definite diagnosis could not be made In March of 1954 the patient became ill with severe abdominal pain and a splenectomy was done without the knowledge of the author Microscopic examination of the spleen was equivocal also The patient died before leaving the hospital

Recent review of the original slides indicates sufficient evidence to make a diagnosis of lymphosarcoma, Hodgkin s type (see Fig 4)

Case 8 A 63-year-old white man was seen on January 8 1951 The only significant abnormal finding was two discrete lymph nodes in the submental region from 1½ 2 cm in diameter These nodes were removed two weeks later and a diagnosis of giant follicular hyperplasia made Since this is usually a form of lymphoblastoma in an early stage of development, the likelihood of the presence of a serious disease was immediately considered (see Fig 5)

During the next 10 months he developed no other findings except slight weight loss Contact with the patient was lost at this time

There is recent information to the effect that the patient developed generalized lymphadenopathy and died in August 1951 18 months after he was first seen

Case 9 A 58-year-old white man of Greek extraction was first seen on January 10 1947 Fifteen months previously he had developed an enlarged lymph node in the left side of his neck. Several months previously the node had subsided following Roentgen ray treatment On February 18 1947 there were two enlarged nodes in the left side of the neck just anterior to the sternomastoid muscle. Report of the microscopic examination of one of these nodes contained the statement The areas with spindle shaped cells are suggestive of sarcoma but it is felt that this tumor is a carcinoma (see Fig. 6) Diagnosis metastatic carcinoma Grade 4 The response to X ray was good on several occasions

Two-and-one-half years later (1949) he developed enlarged axillary lymph nodes

In November 1950 bony metastasis developed and a compression fracture of the dorsal vertebrae occurred

In January 1951 there was infiltration of the pterygo-maxillary fossa with extension of swelling into the left pyriform sinus and the epiglottic area He died in the summer of 1951 about six years after first symptoms.

It is, of course, possible that this patient had a primary tumor of the pharynx that was sensitive to the original Roentgen treatment, but that is not too consistent with the subsequent course and duration of the disease

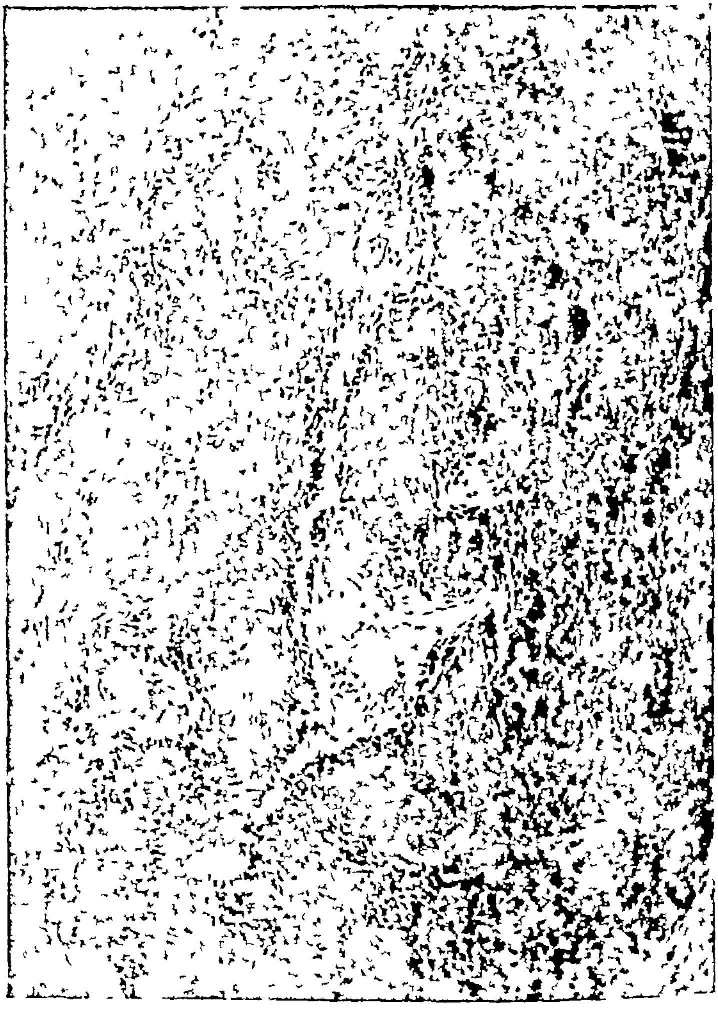

Fig 7 Metastatic Carcinoma Grade 4 (Transitional or Lymphoepithelioma Type) (x 175)

Case 10 A white woman 67 years old was seen June 15 1946 There was a history of having had a lymph node removed from the left side of the neck 12 years previously Six years previously a swelling appeared at the left angle of the mandible and several Roentgen treatments had been given

On the admission examination there was noted enlargement of the left mastoid lymph node It was soft and tender This area had also been irradiated five years previously Sixteen months later on September 12 1947 a section of the node was removed It had suppurated and ruptured through the capsule The pathological report was transitional cell carcinoma There was no evidence of a primary tumor in the ear nose or throat and general and Roentgenological examinations including pyelograms were negative

In January 1948 there was Roentgenological evidence of metastatic malignancy of the skull and one month later there was metastasis to the femur

The patient died April 25 1948 with generalized carcinomatosis The primary site unknown (See Fig 7)

An attempt has been made to further the interest of the otolaryngologist in lymphoblastoma From a review of the literature for the past 25 years the relative frequency of the extra nodal lesions has been recorded

The factors concerned in the clinical diagnosis and its correlation with pathological reports has been discussed from the standpoint of the management of patients with primary involvement of the cervical lymph nodes

Brief reports have been made to illustrate the variety of cases encountered by the otolaryngologist

It is recommended that the otolaryngologist who assumes responsibility in the neck familiarize himself not only with the appearance and "feel" of all varieties of normal necks, but also those involved by tumors This will be especially advantageous in lymphoblastoma of the cervical lymph nodes when there is no extra nodal local lesion from which biopsy can be obtained This experience is also quite valuable when pathological diagnosis cannot be made in the presence of the disease

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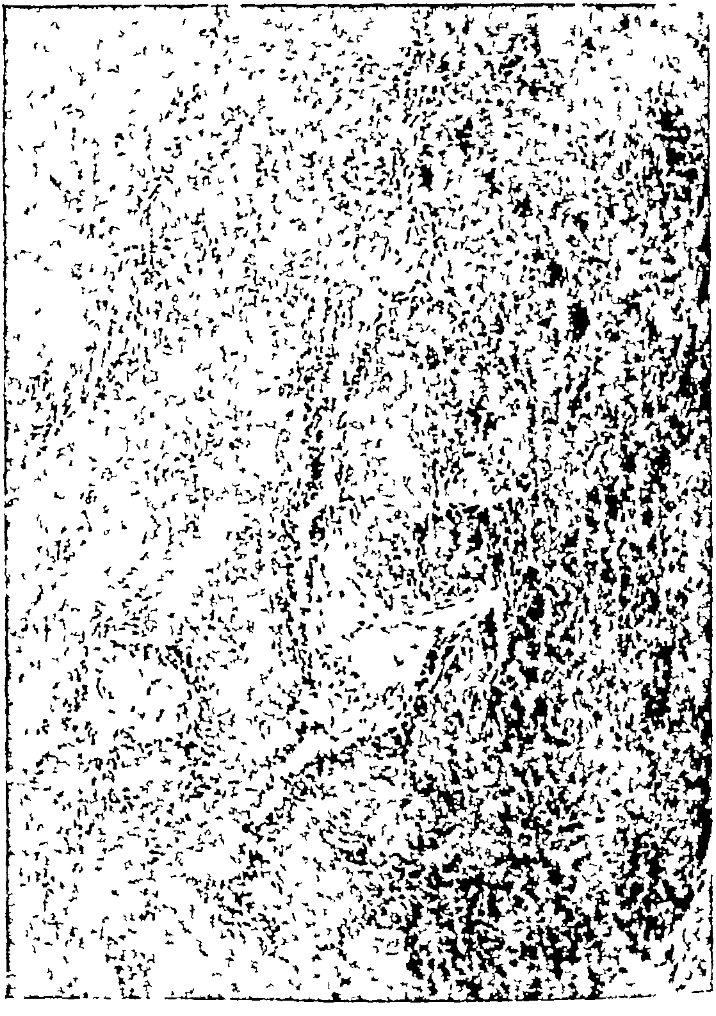

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RESTORATION OF HEARING IN OTOSCLEROSIS BY MOBILIZATION OF THE FIXED STAPEDIAL FOOTPLATE AN ANALYSIS OF RESULTS[*]

SAMUEL ROSEN, M D[†]

With Technical Assistance of

MOE BERGMAN, Ed D[‡]

New York, N Y

Restoration of hearing in otosclerosis by operative treatment has been the most vital contribution to otology in this Century Lempert's great contribution in fenestration surgery is known to all In recent years the author has been engaged in attempting to restore hearing in otosclerosis by mobilizing the fixed stapedial footplate The quest for a simple surgical procedure to restore hearing has led to the development of the technique to be described

In December, 1952, the author reported[1] his first case of restoration of hearing in otosclerosis treated by this method The patient (E L) was operated upon in April, 1952 Normal hearing resulted in the treated ear and has been maintained to the present (see Audiogram, Case 1) Additional communications[2,3,4,5,6,7,8,9] with case reports have demonstrated that the procedure developed and employed by the author can mobilize the fixed stapedial footplate and restore useful and sometimes normal hearing

Ideally, a surgical procedure for otosclerotic deafness should re-establish the normal function of nature's pathway of sound conduction, *i e* , *1* An intact and freely mobile ossicular chain

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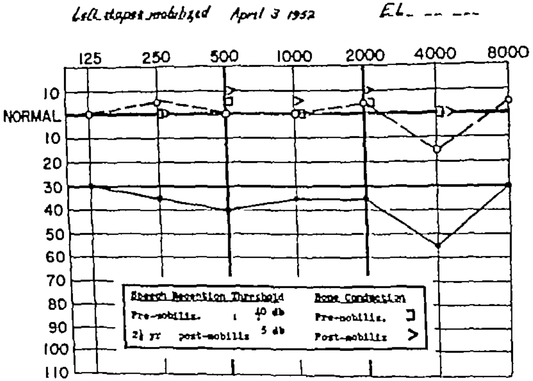
terminating in 2 A freely movable stapedial footplate in 3 Nature's oval window The technique presented here was, therefore, devised in the belief that hearing would be restored if the fixed stapedial footplate could once again be rendered freely movable



Case 1. E L. The solid line indicates the air conduction audiogram for the left ear just before mobilization of the fixed stapedial footplate. The dashed line audiogram shows the threshold for the same ear 35 months after the operation. The speech reception thresholds for the same period are also shown.

In evaluating this procedure, certain key questions must be answered The main questions are

1 Can the fixed stapedial footplate be mobilized?

2 If the fixed footplate can be mobilized will this restore hearing and to what degree?

3 Will hearing restored by this method last?

4 Is the hearing made worse by mobilization?

5 What are the indications for this new procedure?

6 What are the significant features of this technique?

7 Are there complications?

8 What surgical and technical factors contribute to success or failure?

9 What other factors contribute to success or failure?

10 Can improved hearing result from the fenestration operation on the side in which the rigid stapes could not be mobilized?

11 Conversely, can improved hearing result from the mobilization of the fixed stapedial footplate on the side in which the fenestration operation has failed?

The purpose of this communication is to provide a critical evaluation and analysis of results obtained by the mobilization operation in an attempt to answer the questions posed in this paper

HISTORY

Kessel[10] in 1876 attempted to improve hearing in stapes ankylosis resulting from suppuration by removing the drum, malleus and incus Later Kessel tried mobilization and then complete removal of the stapes Boucheron[11] in 1888, reported mobilization of the stapes in 60 cases after separating the incus from the stapes and excising the posterior half of the drum Miot[12] in 1890 reported good results in a series of 200 cases of stapes mobilization In some cases he operated the same ear three times within the first few months

In America, Blake,[13] Jack,[14] and Burnett[15] (1891-1893) similarly employed mobilization of the stapes, but soon turned to stapedectomy Faraci[16] in 1899, reported limited success with mobilization He predicted that a great stride in scientific progress would be made when the technique for stapes mobilization was ultimately perfected Others attempted various operations to mobilize or extract the stapedial footplate.

Siebenmann[17] in 1900, stated that all operations on the stapes, mobilization or stapedectomy, were useless *In all these operations the attempt to mobilize the stapes was through a myringotomy* It may be that in many cases myringotomy did not provide sufficient vision of the stapes to allow precise manipulation These operations were finally abandoned over 50 years ago in favor of attempts to create a new window into the labyrinth, which has resulted in the present-day fenestration operation of Lempert

TECHNIQUE FOR MOBILIZATION OF FIXED FOOTPLATE OF STAPES (ROSEN)

The operation is performed under local anesthesia through an ordinary ear speculum in the external auditory canal using the Zeiss Cameron loupe One to two cc. of mixture of three parts 2 per cent Xylocaine and one part adrenaline chloride 1/1000 is injected subcutaneously into the skin of the posterior wall, roof, anterior wall and floor at the junction of the cartilage and bone

An incision is made through the skin over the bony canal wall 6 to 7 millimeters external to the drum beginning postero-superiorly at the point of junction of the pars flaccida and pars tensa of the drum (It is always best to begin the incision higher rather than lower) The incision is carried downward along the posterior wall, floor and anterior wall as far as the point where the pars tensa and flaccida meet antero-superiorly (see Fig 1)

The skin is separated from the bone as far as the edge of the drum with instruments Nos 2 and 3 (previously used by Lempert in tympanosympathectomy) starting the separation at the beginning of the incision The tympanum is first entered about a millimeter or two below the beginning of the incision From this point of entry into the tympanum the drum is progressively lifted out of its sulcus It is reflected upward upon itself like an apron with the instrument No 4 This is essentially the same approach to the tympanum as that used by Lempert in his tympanosympathectomy operation.[16]

In over 85 per cent of the cases more or less of the incudo stapedial joint is seen at once The stapes however, cannot be seen sufficiently to allow safe manipulation, therefore, about two to three millimeters of the very edge of the posterior bony canal just external to the incus and stapes must be removed with instrument No 5 in order to get a full view of the long process of the incus, the incudo-stapedial junction the head neck, sometimes the crura and the footplate of the stapes facial canal the entire length of the stapedius tendon,

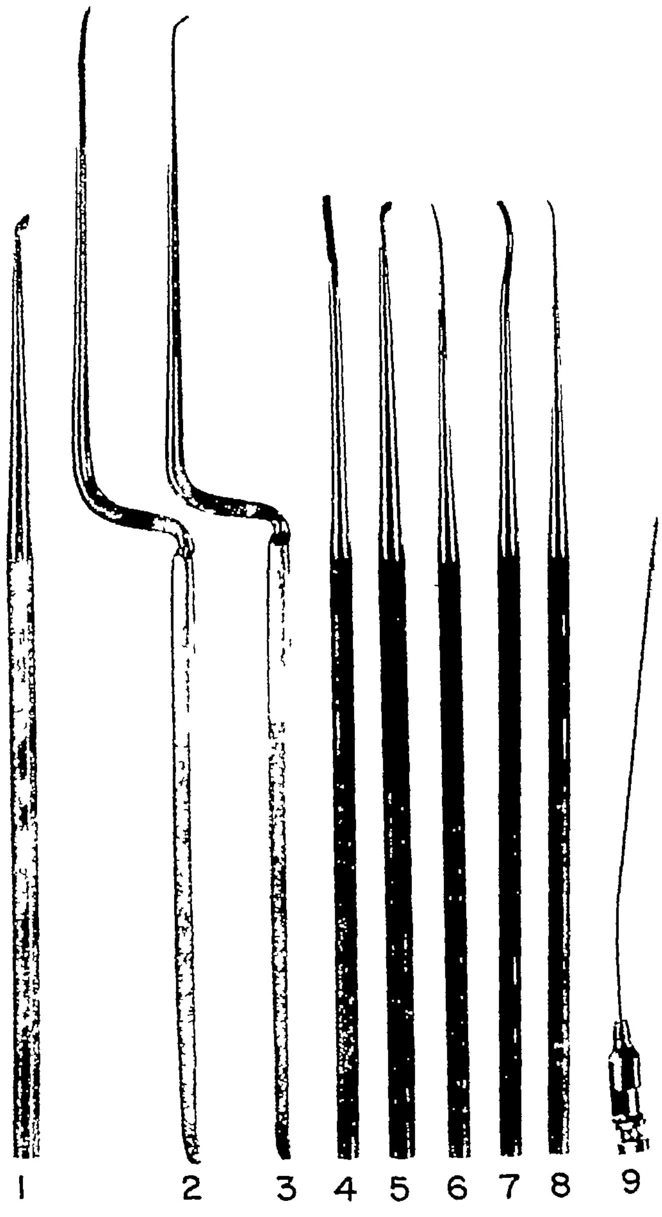


Fig 1 Instruments numbered in the order in which they are used in mobilization of the stapes

chorda tympani nerve, a portion of the incudo-malleolar articulation and the inner aspect of the hammer handle

To test for mobility of the footplate of the stapes, a finely pointed probe (instrument No 6) is placed against the long process of the incus close to its articulation with the stapes and moved gently downward for a distance of about a half-millimeter (see Fig 2) When the normal footplate of the stapes is freely movable in the oval window the gentlest

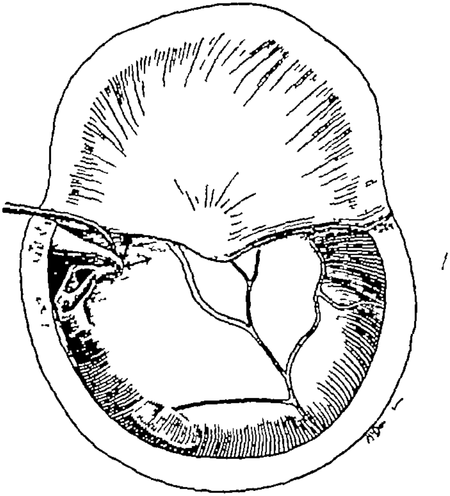


Fig — Drum and skin are reflected and a wide exposure of the long process of the incus, stapes and stapedial tendon is made after the edge of the bony canal wall is removed Palpation is then made to determine stapedial fixation

pressure of the probe against the long process of the incus causes free and unimpeded movement of the incus, the incudo-stapedial joint, the head, neck, crura of the stapes and stapedial tendon The tendon of the stapedius is the structure to watch at all times, since its movement is the reflection of the footplate movement. The footplate of the stapes moves invariably whenever the head and crura move, and when this happens the tendon invariably moves in proportion to the movement of the stapes

These structures can all be seen to move together as one The operator can also feel these structures moving This associated sight and feel must be experienced often to master the technique When the stapes is partially or incompletely fixed, it takes greater pressure of the probe against the long process of the incus to move the above structures even slightly, as measured again by the degree that the tendon can be seen to shorten and lengthen Again, these structures can be seen to move together as one, however minutely, but when the footplate of the stapes is completely fixed, very firm pressure of the probe against the long process of the incus causes the incus alone to move, but there is no movement whatever of the head, crura, footplate or tendon of the stapes

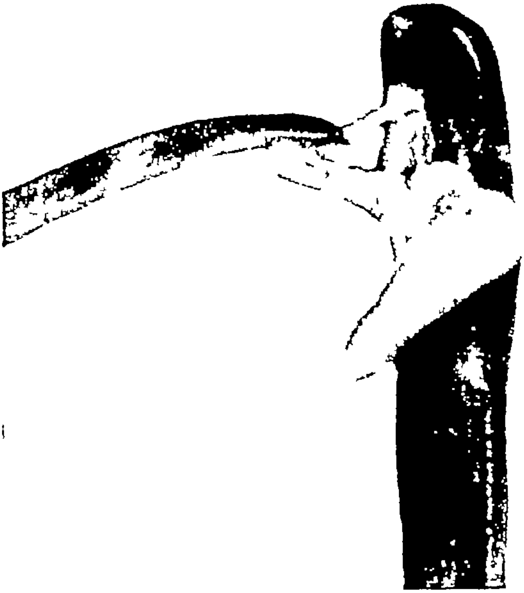


Fig 3 Pressure of mobilizer (Instrument No 7) against the neck of the stapes mobilizes the footplate without violating the incudo-stapedial joint.

When the stapes is rigidly fixed (stapes removed from cadavers and fixed in cement offer good practice to get the feel of the otosclerotic rigid stapes) variable pressure downward against the neck (only the neck, because it is the thickest and strongest part of the stapes) may suddenly loosen the footplate with immediate improvement in hearing For this purpose a specially curved, narrow mobilizer was devised (instrument No 7) The palpating edge of the mobilizer is first inserted over the incudo-stapedial joint and is carried inward until one can feel the anterior crus of the stapes close to the footplate The instrument is pulled gently upward and outward hugging the anterior crus until one suddenly feels a dent or depression, which is the neck of the stapes At this point the stapes withstands the greatest pressure without fracture of the crura (see Fig 3)

Pressure downward in the line of the stapedial tendon is made until the stapes is mobilized The direction of the stapedial tendon roughly follows the same direction as the crura and the long axis of the footplate, however, when one or both crura can be seen, the direction of the pressure against the neck of the stapes is in the line of the crura Very slight pressure laterally against the neck of the stapes may help to mobilize it (see Fig 2) The amount of pressure which can be exerted on the neck of the fixed stapes without fracturing the crura is considerable

If during the procedure adhesions or granulations involving the ossicles or round window are encountered they may be dealt with, (using instrument No 8) A rounded and slightly bent spinal tap needle is used for suction (instrument No 9) When the operation is finished, the drum and the attached skin of the external auditory canal are placed back in their original positions The ossicular chain remains intact

It is my conviction that generally procedures of this kind should be performed only by those skilled in endaural surgery For the mobilization operation even the skillful surgeon should perform the operation on at least 50 fresh cadavers before the first patient is operated upon This number seems to be the minimum required, because of the great number of anatomical variations One must learn to do the operation skillfully through external auditory canals which are wide, narrow or tortuous Also in many specimens the posterior bony canal wall is concave, and the anterior canal wall is convex Separating the skin from the bony wall without tearing it or injuring the drum in such cases is difficult and should be learned on the cadaver

This operation appears deceptively simple, yet learning to perform it skillfully is not, because all maneuvers are restricted by the limits of the bony external canal In early cadaver practice all canals seem quite narrow To some this is an unfamiliar approach to intratympanic surgery

Personal communications to the author of some of the early results of the operation performed by others in the living might indicate insufficient practice on the cadaver

Can the Fixed Stapedial Footplate Be Mobilized?

When pressure against the neck of the rigid stapes is suddenly accompanied by improved hearing, it can be inferred that the rigid footplate has been mobilized When this occurs the visible portion of the stapes and its attached tendon can be felt and seen to move together On the other hand, when the pressure against the neck of the stapes causes it and the attached stapedial tendon to move very freely, but the hearing does not improve at once, it must be inferred in most cases that a fracture of the crura has occurred (sometimes with an audible crack) leaving the footplate fixed Crural fracture seems to be the most common cause of failure in this procedure In the author's experience it is difficult in many cases to discriminate between a mobilized footplate and fractured crura, since in both the stapedial tendon moves on palpation of the long process of the incus

When a drop of saline solution is placed in the round window niche and the mobilized stapes is moved back and forth at its neck, a light reflex can sometimes be seen of this fluid moving in the round window niche The movement of the saline solution in the round window niche is the result of the presure transmitted through the cochlea from the movable stapedial footplate This is seen best with the microscope

If the Fixed Footplate of the Stapes Can Be Mobilized Will This Restore Hearing and to What Degree?

The answer to this question can best be determined by a critical analysis of the positive and negative results in all patients who had the mobilization operation for otosclerotic deafness In every case reported the stapes was found to be fixed The data in this report are based on 211 consecutive cases operated on between April, 1952, and August, 1954 This includes every patient with otosclerosis who had the mobilization operation during this period Seven of these patients were from the Otolaryngological Service at the Mount Sinai Hospital and the rest were private patients In order to apply a rigid statistical evaluation in reporting results of this new procedure, all cases in which available data were insufficient for analysis are counted here as failures

TESTS TEST AREA EQUIPMENT AND PERSONNEL

In all cases, routine tests of hearing for the diagnosis of otosclerotic deafness included pure tone air and bone conduction threshold audiometry speech reception thresholds using spondee words speech discrimination scores using PB words, and tests for tolerance levels to spondee words and white noise Where indicated, recruitment tests were done to differentiate cochlear from middle ear deafness

All tests, both pre- and post-operative, except those on hospital service cases, were performed in rooms in which the ambient noise level measured on the "A" scale of a General Radio 1551-A sound level meter was between 35 and 40 db

Two pure tone audiometers were used, an Audivox 7-B and a Peters SPD 2 (Sonotone Model 23) the latter with a Sonotone bone oscillator The air and bone reference levels were checked periodically on subjects with normal hearing Speech audiometry was performed by feeding tape recorded spondee and PB word lists from Pentron Model PBA-2 tape players through the pure tone audiometers utilizing the attenuators and earphones of the latter Threshold calibrations were determined by testing normal listeners

Two audiologists Dr Moe Bergman and Miss Phyllis Fried man, and the surgeon, performed the pre- and post-operative hearing tests in random order

CLASSIFICATION OF CASES

The cases reported here are divided into four categories, *A*, *B*, *C* and *D*, based upon the pre-operative bone conduction thresholds

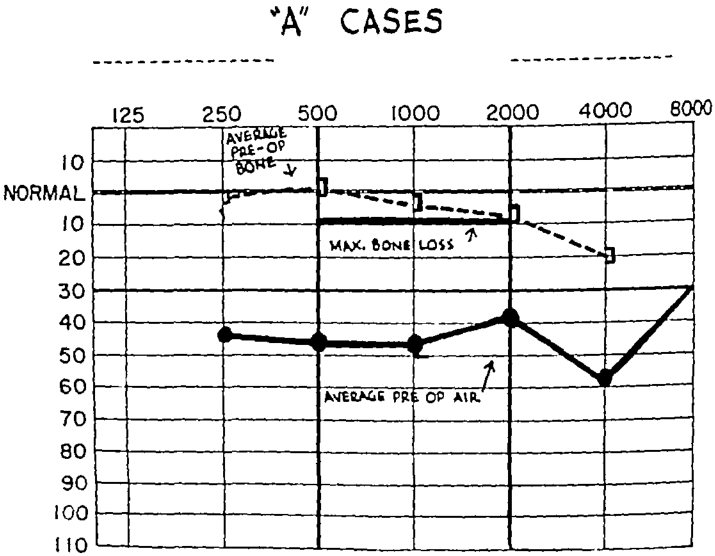


Fig 5 A Cases Mean pre-operative thresholds for air and bone in 5 A cases reported here

A This includes all cases with pre-operative maximum bone conduction losses as follows

at 500 cps — 10 db

at 1000 cps — 10 db

at 2000 cps — 10 db

The average pre-operative loss of hearing by air conduction in the speech frequencies for these cases was 43 9 db (see Fig 5)

B This includes all patients not included in the *A* category who had maximum bone conduction losses as follows

at 500 cps — 20 db
at 1000 cps — 20 db
at 2000 cps — 20 db

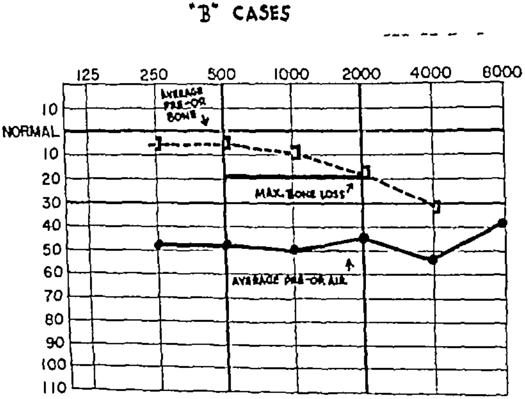


Fig 6 B Cases. Mean pre-operative thresholds for air and bone in 93 B cases reported here

The average pre-operative loss of hearing by air conduction in the speech frequencies was 47 5 (see Fig 6)

C This includes all patients not eligible for *A* and *B* categories who had maximum bone conduction losses as follows

at 500 cps — 30 db
at 1000 cps — 30 db
at 2000 cps — 30 db

The average pre-operative loss of hearing by air conduction in the speech frequencies was 54 1 db (see Fig 7)

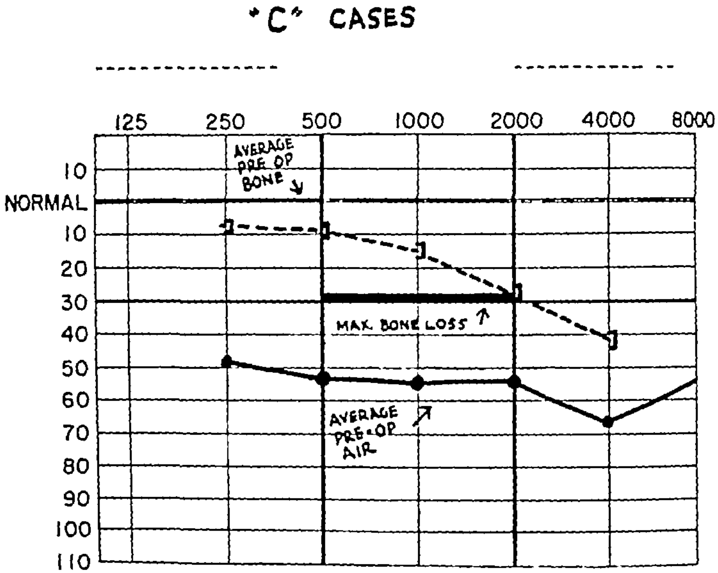


Fig 7 C Cases. Mean pre operative thresholds for air and bone in 56 C cases reported here

D This includes all patients with pre-operative maximum bone conduction losses greater than 30 db at one or more of the critical frequencies Thirty-eight such cases were operated on and are reported

The effect of the operation upon hearing was tabulated by pure tone and speech reception threshold changes, both of which are reported

A Cases Twenty-five cases are reported with pure tone and speech audiometry data Thirteen or 52 per cent of these patients improved 15 db or more over their pre-operative pure tone levels to achieve a hearing level of 35 db or better Twelve of the thirteen who were improved, or 48 per cent of the total *A* group, reached 30 db or better Sixteen, or 64 per cent, improved to the 35 db level or better by speech audiometry The hearing of five in this group reached a post-operative level of 20 db or better by pure tone and speech udiometry, while two patients in this group now enjoy a e tone lev between zero and ten db Twelve of the 25 ed in egory showed no change of pure tone d foll operation, or insufficient gain to reach the 35 db level They are listed in the table of Class *A* patients as unimproved. The post-operative improvement to the 30 db level is shown in order to conform to the standard set by fenestration The post-operative improvement to the 35 db level is also given, because many patients who reach this level from a profound loss seem to show little impairment of the hearing function

TABLE I

Results of Mobilization of the Fixed Stapedial Footplate in *A* category cases.

	Pure Tone Average (500 1000 000 cps)		Spondee Threshold	
Number Reported	25		40 8 db	
Average Pre-Op Losses	43 9 db		25	
Post Op. Audio metric Level	No of Cases	Per Cent	No of Cases	Per Cent
0–10 db	2	8.0%	1	4%
11–20 db	3	12.0%	4	16%
21–30 db	7	28 0%	7	28%
31 35 db	1	4 0%	4	16%
Total Improved	13	52 0%	16	64%
Unimproved	12	48 0%	9	36%

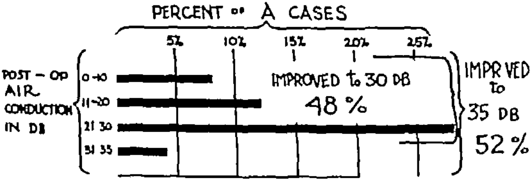


FIG 8 The graph shows the per cent of 25 A cases showing improvement to the various pure tone threshold levels following mobilization of the fixed footplate of the stapes

In this category the post-operative periods ranged from three to 30 months, with an average of 15 months between the time of operation and the last post-operative tests

In those *A* cases in which the hearing was improved following the operation, the average improvement for pure tones in the speech range (500, 1000, 2000 cps) was 24 0 db The average post-operative level was 19 7 db The average spon-

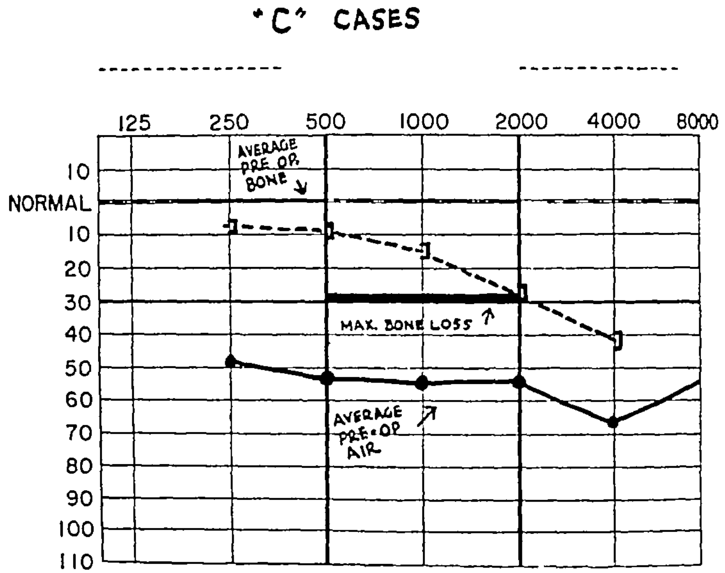


Fig 7 C Cases Mean pre-operative thresholds for air and bone in 56 C cases reported here

D This includes all patients with pre-operative maximum bone conduction losses greater than 30 db at one or more of the critical frequencies Thirty-eight such cases were operated on and are reported

The effect of the operation upon hearing was tabulated by pure tone and speech reception threshold changes, both of which are reported

A Cases Twenty-five cases are reported with pure tone and speech audiometry data Thirteen or 52 per cent of these patients improved 15 db or more over their pre-operative pure tone levels to achieve a hearing level of 35 db or better Twelve of the thirteen who were improved, or 48 per cent of the total *A* group, reached 30 db or better Sixteen, or 64 per cent, improved to the 35 db level or better by speech audiometry The hearing of five in this group reached a post-operative level of 20 db or better by pure tone and speech audiometry, while two patients in this group now enjoy a pure tone level between zero and ten db Twelve of the 25 reported in this category showed no change of pure tone threshold following the operation, or insufficient gain to reach the 35 db level They are listed in the table of Class *A* patients as unimproved. The post-operative improvement to the 30 db level is shown in order to conform to the standard set by fenestration The post-operative improvement to the 35 db level is also given, because many patients who reach this level from a profound loss seem to show little impairment of the hearing function

TABLE I.

Results of Mobilization of the Fixed Stapedial Footplate in *A* category cases.

	Pure Tone Average (500 1000 2000 cps)		Spondee Threshold	
Number Reported		25	49 8 db	
Average Pre-Op. Losses		43 9 db	25	
Post Op Audiometric Level	No of Cases	Per Cent	No of Cases	Per Cent
0–10 db	2	8 0%	1	4%
11–20 db	3	12 0%	4	16%
21–30 db	7	28.0%	7	28%
31 35 db	1	4 0%	4	16%
Total Improved	13	52 0%	16	64%
Unimproved	12	48 0%	9	36%

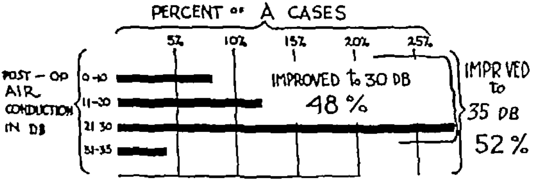


FIG 8 The graph shows the per cent of 25 A cases showing improvement to the various pure tone threshold levels following mobilization of the fixed footplate of the stapes

In this category the post-operative periods ranged from three to 30 months, with an average of 15 months between the time of operation and the last post-operative tests

In those *A* cases in which the hearing was improved following the operation, the average improvement for pure tones in the speech range (500, 1000, 2000 cps) was 24 0 db The average post-operative level was 19 7 db The average spondee gain was 22 1 db The average improvement at each frequency is shown numerically in Table II and graphically in Fig 9

TABLE II

Comparison of average pre-operative and post-operative pure tone levels in 13 improved A cases

	Frequency						
	250	500	1000	2000	4000	8000	Average (500 2000)
Pre-Op Level (db)	43 8	45 9	46 9	38 5	50 8	30 9	43 7
Average Gain (db)	25 5	27 1	24 6	20 4	14 0	14 3	24 0
Post Op Level (db)	18 3	18 8	22 3	18 1	36 8	15 7	19 7

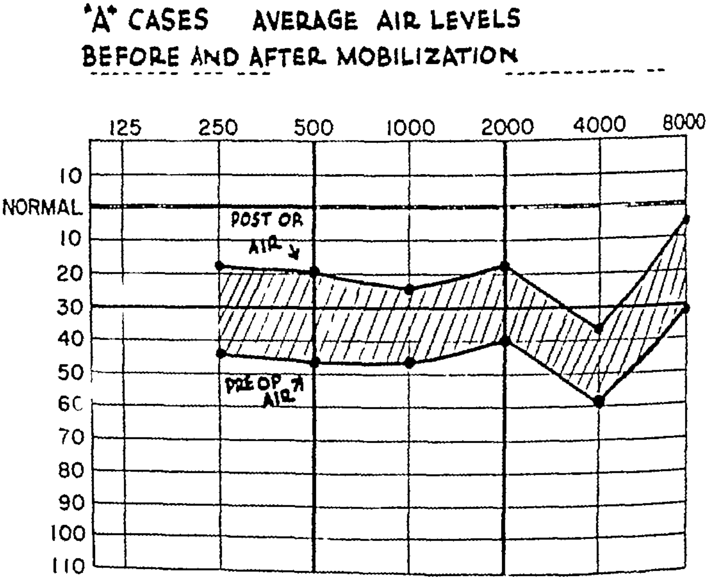
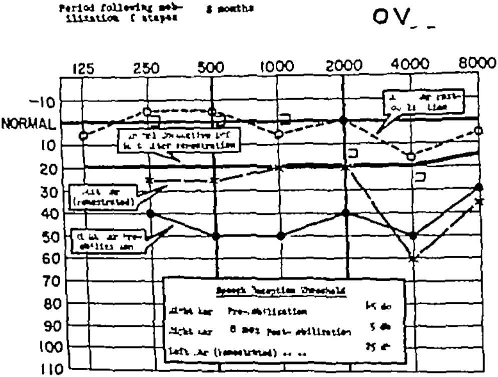


Fig 9 Mean pre-operative and post-operative pure tone air conduction thresholds are shown for 13 improved A cases

Nine months ago the opportunity came to compare both ears in the same patient following mobilization in one ear and fenestration in the other According to McConnell and Carhart,[19] and Davis and Walsh,[20] the minimal conductive deficit after fenestration is 20 db, as shown on the comparative audiogram of O V

O V a 38 year-old seaman had bilateral progressive deafness for three or four years In June 1953 a left fenestration was performed by another surgeon The post fenestration hearing in the left ear had reached its maximum (20 db) In April 1954 the right rigid stapes was mobilized and within three weeks the right ear had gained maximum improvement (to less than the 5 db level) which has been maintained for the past eight months (see Audiogram Case 2 O V)



Case O V This audiogram represents the comparative maximum effects from fenestration and mobilization

BONE SHIFTS IN *A* CASES

The reversal of part of the pre-operative loss by bone conduction following successful fenestration has been widely reported by many observers Carhart, McConnell and others have presented statistical evidence in support of this observation Carhart postulated that the "bone shifts" were related to the restoration of proper fluid dynamics in the internal ear after the new fenestra has been made With this in mind, a study was made of the data on bone conduction thresholds before and after successful mobilization of the fixed stapedial footplate Table III shows the pre- and post-operative bone thresholds of the 13 improved cases in category *A*

TABLE III

Comparison of average pre-operative and post-operative bone conduction levels in 13 improved *A* cases
The minus value indicates increased loss

	Frequency 250	500	1000	2000	4000
Pre Op Bone Level (db)	1 9	0 0	4 3	6 7	19 5
Gain in db	–0 6	–3 1	–1 3	–8 1	–9 2
Post Op Bone Level (db)	2 5	3 1	5 6	14 8	[illegible]

The order of the shift in *A* cases seems to be the reverse of that generally reported for fenestration cases It has been noted that in successful *A* cases the Rinné which was negative before operation becomes positive after operation

B Cases Seventy-nine cases are reported by pure tone and speech audiometry data, and an additional 13 cases by speech audiometry results alone The pure tone and speech audiometry results are reported separately Thirty-one patients, or 39 3 per cent, achieved a post-operative pure tone level of 35 db or better Twenty-five, or 32 per cent, heard better than the 30 db pure tone level post-operatively Twelve, or 15 per cent, had a post-operative hearing loss of only 20 db or better, and in five patients in this category the hearing returned to between zero and 10 db following successful mobilization of the fixed stapedial footplate

TABLE IV

Results of Mobilization of the Fixed Stapedial Footplate in *B* Category Cases

	Pure Tone Average (500 1000 2000 cps)		Spondee Threshold	
Number Reported	79		92	
Average Pre Op Losses	47 5 db		51 9 db	
Post-Op Audiometric Level	**No of Cases**	**Per Cent**	**No of Cases**	**Per Cent**
0–10 db	5	6 3%	4	4 4%
11–20 db	7	8 9%	11	12 0%
21–30 db	13	16 5%	16	17 4%
31–35 db	6	7 6%	7	7 6%
Total Improved	31	39 3%	38	41 4%
Unimproved or No Follow Up	48	60 7%	54	58 6%

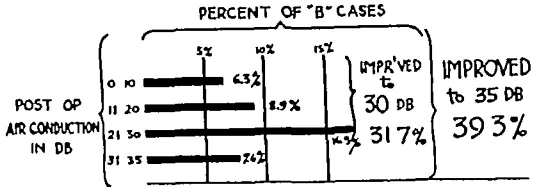


Fig 10 The graph shows the per cent of 70 B cases showing improvement to the various threshold levels following mobilization of the fixed footplate of the stapes.

In this category the post-operative period ranged from two to 21 months, with an average of 7 4 months between the time of operation and the last post-operative tests

In those *B* cases which improved following the operation, the average improvement for pure tones in the speech range (500, 1000, 2000) was 25 0 db The average post operative level was 22 9 db Of the 31 improved *B* cases, 12, or more than one out of three, reached a post-operative audiometric level of 20 db or better The average gain in spondee threshold for the improved *B* group was 25 5 db The average improvement in each frequency is shown numerically in Table V, and graphically in Fig 11

TABLE V

Comparison of average pre-operative and post-operative pure tone levels in 31 improved *B* cases

	Frequency						
	250	500	1000	2000	4000	8000	Average (500 2000)
Pre-Op Level (db)	48 6	48 5	49 9	45 3	53 4	38 6	47 9
Average Gain (db)	27 7	25 0	24 8	25 3	24 4	7 8	25 0
Post-Op Level (db)	20 9	23 5	25 1	20 0	29 0	30 8	22 9

TABLE III

Comparison of average pre-operative and post operative bone conduction levels in 13 improved *A* cases
The minus value indicates increased loss

	Frequency 250	500	1000	2000	4000
Pre-Op Bone Level (db)	1 9	0 0	4 3	6 7	19 8
Gain in db	–0 6	–3 1	–1 3	–8 1	–9 2
Post Op Bone Level (db)	2 5	3 1	5 6	14 8	29 0

The order of the shift in *A* cases seems to be the reverse of that generally reported for fenestration cases It has been noted that in successful *A* cases the Rinné which was negative before operation becomes positive after operation

B Cases Seventy-nine cases are reported by pure tone and speech audiometry data, and an additional 13 cases by speech audiometry results alone The pure tone and speech audiometry results are reported separately Thirty-one patients, or 39 3 per cent, achieved a post-operative pure tone level of 35 db or better Twenty-five, or 32 per cent, heard better than the 30 db pure tone level post-operatively Twelve, or 15 per cent, had a post-operative hearing loss of only 20 db or better, and in five patients in this category the hearing returned to between zero and 10 db following successful mobilization of the fixed stapedial footplate

TABLE IV

Results of Mobilization of the Fixed Stapedial Footplate in *B* Category Cases

	Pure Tone Average (500 1000 2000 cps)		Spondee Threshold	
Number Reported	79		92	
Average Pre-Op Losses	47 5 db		51 9 db	
Post-Op Audiometric Level	No of Cases	Per Cent	No of Cases	Per Cent
0–10 db	5	6 3%	4	4 4%
11–20 db	7	8 9%	11	12 0%
21–30 db	13	16 5%	16	17 4%
31–35 db	6	7 6%	7	7 6%
Total Improved	31	39 3%	38	41 4%
Unimproved or No Follow Up	48	60 7%	54	58 6%

Forty nine cases in this category are reported with pure tone and speech audiometry data, and an additional seven are shown with speech audiometry results alone The pure tone and speech audiometry results are reported separately Thirteen patients, or 26 6 per cent, achieved a post-operative pure tone level of 35 db or better Eight patients or 16 4 per cent reached a level of 30 db or better Four patients in this category reached a post-operative level of 20 db or better By speech audiometry, 16 or 29 per cent, reached a post-operative level of 35 db or better, while 12 or 21 4 per cent, reached a level of 30 db or better

TABLE VII.

Results of Mobilization of the Fixed Stapedial Footplate in *C* Category Cases

	Pure Tone Average (500 1000 000 cps)		Spondee Threshold	
Number Reported	49		56	
Average Pre-Op Loss	54.1 db		57 7 db	
Post Op Audiometric Level	No of Cases	Per Cent	No of Cases	Per Cent
0–10 db	0	0	1	1 8%
11–20 db	4	8 2%	4	7.1%
21–30 db	4	8 2%	7	12.5%
31–35 db	5	10.2%	4	7 1%
Total Improved	13	26 6%	16	28 5%
Unimproved or No Follow Up	36	73 4%	40	71 5%

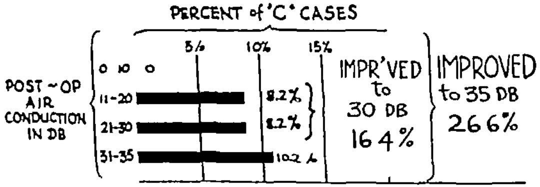


Fig 12 The graph shows the per cent of 49 C cases showing improvement to the various pure tone threshold levels following mobilization of the fixed footplate of the stapes

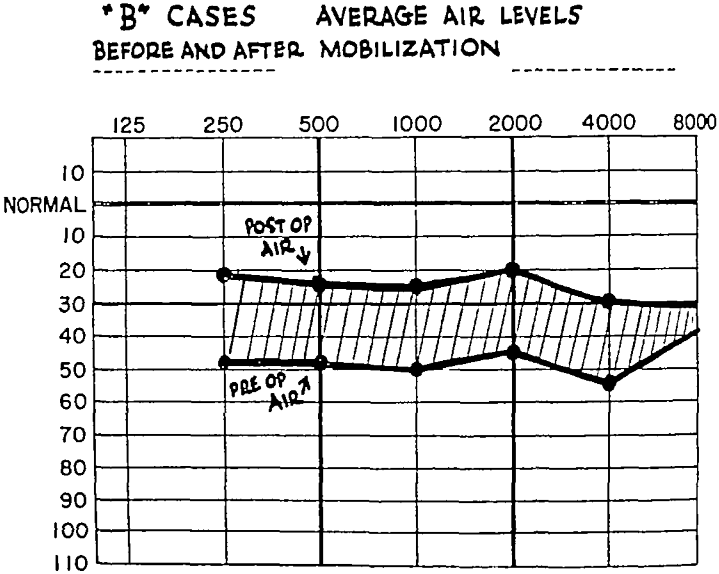


Fig 11 Mean pre operative and post-operative pure tone air conduction thresholds are shown for 31 improved B cases

BONE SHIFTS IN *B* CASES

In contrast to the cases in *A* category, there was some gain in hearing by bone post-operatively in the *B* group as shown in Table VI

TABLE VI

Comparison of average pre-operative and post-operative bone conduction levels in 31 improved *B* cases

	Frequency				
	250	500	1000	2000	4000
Pre-Op Bone Level (db)	6 7	5 6	9 0	17 4	30 8
Gain in db	4 8	6 8	6 5	3 2	4 8
Post Op Bone Level (db)	1 9	−1 2	2 5	14 2	26 0

The average of 5 5 db in the region 500 through 2000 cps in *B* cases approximates that reported by McConnell and Carhart for fenestration cases (5 9 db)

C Cases The percentage of successful results in this category is clearly below that of the *A* and *B* groups

Forty-nine cases in this category are reported with pure tone and speech audiometry data, and an additional seven are shown with speech audiometry results alone The pure tone and speech audiometry results are reported separately Thirteen patients, or 26 6 per cent, achieved a post-operative pure tone level of 35 db or better Eight patients, or 16 4 per cent reached a level of 30 db or better Four patients in this category reached a post-operative level of 20 db or better By speech audiometry, 16 or 29 per cent, reached a post-operative level of 35 db or better, while 12, or 21 4 per cent, reached a level of 30 db or better

TABLE VII

Results of Mobilization of the Fixed Stapedial Footplate in *C* Category Cases.

	Pure Tone Average (500 1000 000 cps)		Spondee Threshold	
Number Reported	49		56	
Average Pre-Op Loss	54 1 db		57 7 db	
Post-Op Audiometric Level	No of Cases	Per Cent	No of Cases	Per Cent
0–10 db	0	0	1	1 8%
11–20 db	4	8.2%	4	7 1%
21–30 db	4	8.2%	7	12 5%
31–35 db	5	10.2%	4	7 1%
Total Improved	13	26 6%	16	28.5%
Unimproved or No Follow Up	36	73 4%	40	71 5%

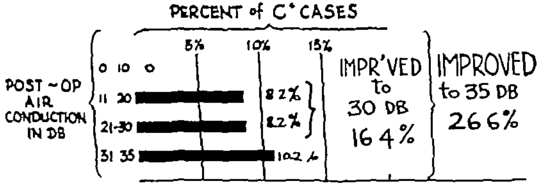


Fig 1 The graph shows the per cent of 49 C cases showing improvement to the various pure tone threshold levels following mobilization of the fixed footplate of the stapes.

In this category the post-operative periods ranged from one to 14 months with an average of 5.3 months between the time of operation and the last post-operative tests

In those cases in which the hearing was improved following mobilization, the average improvement for pure tones was 26.9 db The average post-operative level was 27.2 db The average gain in spondee threshold for the improved C group was 25.7 db

TABLE VIII

Comparison of average pre-operative and post operative pure tone levels in 13 improved *C* cases

	Frequency						
	250	500	1000	2000	4000	8000	Average (500 2000)
Pre Op Level (db)	48.9	53.6	54.7	54.1	65.7	54.6	54.1
Average Gain (d)	25.8	26.9	29.2	24.6	22.3	6.7	26.9
Post Op Level (db)	23.1	26.7	25.5	29.5	43.4	47.9	27.2

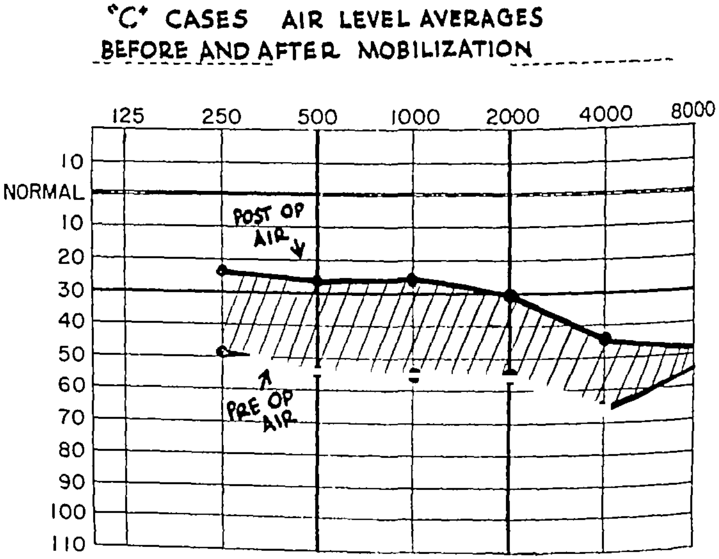


Fig 13 Mean pre-operative pure tone air conduction thresholds are shown for 13 improved C cases The gradual slope toward the high tones post-operatively is related to the poorer bone levels used in selecting cases for this category

BONE SHIFTS IN *C* CASES

The post-operative bone conduction gains in the *C* category are considerably greater than in the *B* category, as shown in Table IX.

TABLE IX.

Comparison of average pre-operative and post-operative bone conduction levels in 13 improved *C* cases.

	Frequency 250	500	1000	000	4000
Pre-Op Bone Level (db)	8.1	9.0	15.1	27.5	41.3
Gain in db	7.3	13.1	13.3	5.4	7.3
Post-Op Bone Level (db)	0.8	−3.1	1.8	22.1	31.0

It is apparent from the results shown that A and B cases (maximum bone conduction loss of 20 db at 500, 1000 and 2000 cps), are most suitable for mobilization. Forty two per cent of the combined *A* and *B* patients reached a post-operative level of 35 db *or* better by *pure* tones (46 per cent by speech audiometry) while 36 per cent reached 30 db or better by pure tones (37 per cent by speech audiometry). If the results of the *C* Cases (maximum pre-operative bone conduction loss *of 30 db at 500, 1000 and 2000 cps) which are gen*erally less suitable are added to the combined *A* and *B* Case results, 37 per cent reached a post-operative level of 35 db or better by pure tones (40 per cent by speech audiometry), while 30 per cent *reached* a level *of* 30 db *or* better by pure tones and 32 per cent by speech audiometry.

D Cases. This category includes all patients whose pre-operative bone conduction loss was greater than 30 db at one, two or three of the speech frequencies (500, 1000, 2000 cps). Of the 211 cases in this series 38 patients who were operated upon belong in this category. In 34 of the 38 patients the hearing loss by bone conduction was greater than 30 db at *2000* cycles only, whereas at 500 and 1000 cycles the hearing by bone was better than 30 db. The pre-operative pure tone air losses in the speech frequencies for the *D* cases ranged from 43 db to 90 db. Ten achieved a gain in hearing ranging from *15 db* to *40* db. Four in this group reached hearing levels of 35 db or better. Of the four, one reached the 15 db level, and one the 20 db level (see H.M. audiogram). On this case, al-

In this category the post-operative periods ranged from one to 14 months with an average of 5.3 months between the time of operation and the last post-operative tests

In those cases in which the hearing was improved following mobilization, the average improvement for pure tones was 26.9 db The average post-operative level was 27.2 db The average gain in spondee threshold for the improved C group was 25.7 db

TABLE VIII

Comparison of average pre-operative and post-operative pure tone levels in 13 improved *C* cases

	Frequency						
	250	500	1000	2000	4000	8000	Average (500 2000)
Pre-Op Level (db) ..	48.9	53.6	54.7	54.1	65.7	54.6	54.1
Average Gain (d) ..	25.8	26.9	29.2	24.6	22.3	6.7	26.9
Post Op Level (db)	23.1	26.7	25.5	29.5	43.4	47.9	27.2

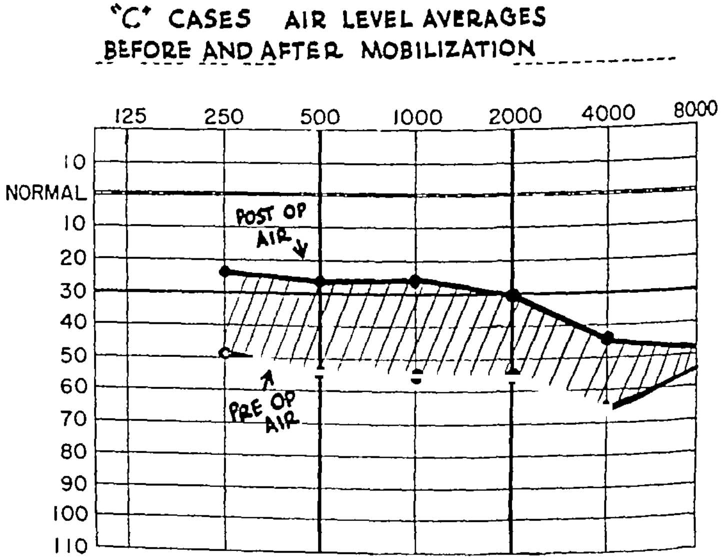


Fig 13 Mean pre-operative pure tone air conduction thresholds are shown for 13 improved C cases The gradual slope toward the high tones post-operatively is related to the poorer bone levels used in selecting cases for this category

BONE SHIFTS IN *C* CASES

The post operative bone conduction gains in the *C* category are considerably greater than in the *B* category, as shown in Table IX.

TABLE IX.

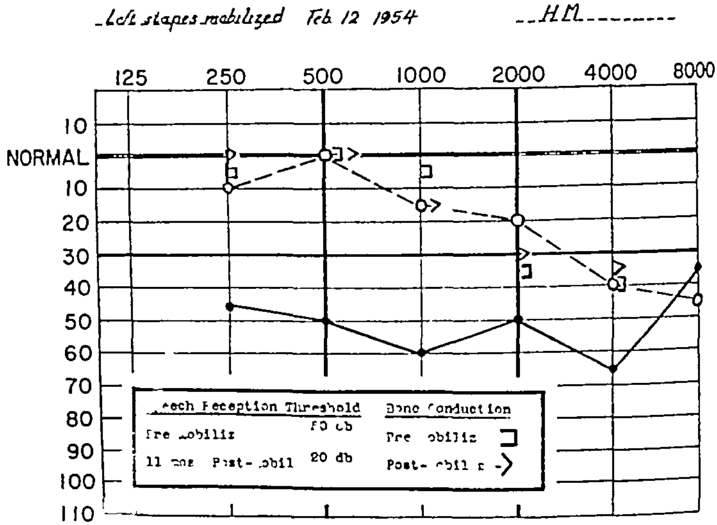
Comparison of average pre-operative and post-operative bone conduction levels in 13 improved *C* cases.

	Frequency 250	500	1000	2000	4000
Pre-Op Bone Level (db)	8.1	9.0	15.1	27.5	41.3
Gain in db	7.3	12.1	13.3	5.4	7.3
Post-Op Bone Level (db)	0.8	-3.1	1.8	22.1	34.0

It is apparent from the results shown that *A* and *B* cases (maximum bone conduction loss of 20 db at 500, 1000 and 2000 cps), are most suitable for mobilization. Forty-two per cent of the combined *A* and *B* patients reached a post-operative level of 35 db or better by pure tones (46 per cent by speech audiometry) while 36 per cent reached 30 db or better by pure tones (37 per cent by speech audiometry). If the results of the *C* Cases (maximum pre-operative bone conduction loss of 30 db at 500, 1000 and 2000 cps) which are generally less suitable, are added to the combined *A* and *B* Case results 37 per cent reached a post operative level of 35 db or better by pure tones (40 per cent by speech audiometry), while 30 per cent reached a level of 30 db or better by pure tones, and 32 per cent by speech audiometry.

D Cases. This category includes all patients whose pre-operative bone conduction loss was greater than 30 db at one, two or three of the speech frequencies (500, 1000, 2000 cps). Of the 211 cases in this series, 38 patients who were operated upon belong in this category. In 34 of the 38 patients, the hearing loss by bone conduction was greater than 30 db at 2000 cycles only, whereas at 500 and 1000 cycles the hearing by bone was better than 30 db. The pre-operative pure tone air losses in the speech frequencies for the *D* cases ranged from 43 db to 90 db. Ten achieved a gain in hearing ranging from 15 db to 40 db. Four in this group reached hearing levels of 35 db or better. Of the four, one reached the 15 db level, and one the 20 db level (see H M audiogram). On this case, although the hearing by bone conduction was poor at 2000 and 4000 cps, it was excellent at 500 and 1000 cps This apparently explains the favorable result

Some of the patients in this category were operated upon with the purpose of improving the hearing sufficiently to increase the benefits to be derived from a hearing aid and other rehabilitation measures This is particularly true in those cases of otosclerosis with considerable cochlear involvement. The ten Class D patients who achieved post-operative gains in hearing of 15 db or more are in this group



Case 3 M The solid lines indicate the air conduction audiogram taken just before mobilization of the fixed footplate of the stapes. The dashed line shows the post-operative threshold In this case the air bone gap appears to have been closed by the operation

AIR-BONE GAPS

The essential feature of this operation is the preservation of nature's sound conducting mechanism, therefore, when the ankylosed stapes is mobilized the normal physiology of hearing is re-established It is not surprising, therefore, that 50 per cent of the patients who reached the 30 db level or better, are able to hear within 15 db of their cochlear potential, as measured by bone conduction

TABLE X.

Residual Air Bone Differences in Improved Cases

Post Op Air Bone Gap	No of Cases	Per Cent of Improved Cases
0–5 db	8	21 0
6–10 db	7	18 4
11–15 db	4	10 5
16–20 db	3	7 9
over 20 db	16	42 1
Total	38	100 0%
Bone conduction data unavailable		13 cases

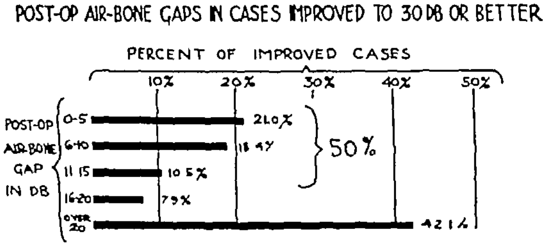


Fig 14 Residual air bone gaps following successful mobilization in A, B and C cases

Will the Hearing Restored by this Technique Last?

Table XI shows the duration of improved hearing for all cases which reached a post-operative level of 35 db or better

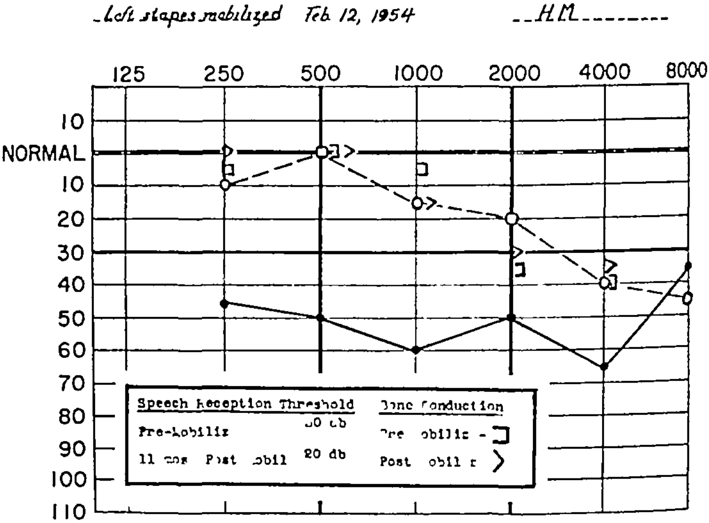
TABLE XI

Duration of Improved Hearing From Mobilization to Most Recent Test

Duration Up to Most Recent Test	No of Improved Patients	Total No Operated
Under 3 months	12	46
3–6 months	24	77
6 months–1 year	14	68
1–2 years	9	18
Over 2 years	2	2
Total	61	206
No follow up		5
Improved then regressed to pre-op level		2

though the hearing by bone conduction was poor at 2000 and 4000 cps, it was excellent at 500 and 1000 cps This apparently explains the favorable result

Some of the patients in this category were operated upon with the purpose of improving the hearing sufficiently to increase the benefits to be derived from a hearing aid and other rehabilitation measures This is particularly true in those cases of otosclerosis with considerable cochlear involvement. The ten Class D patients who achieved post-operative gains in hearing of 15 db or more are in this group



Case 3 H M The solid lines indicate the air conduction audiogram taken just before mobilization of the fixed footplate of the stapes. The dashed line shows the post-operative threshold In this case the air bone gap appears to have been closed by the operation

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TABLE X.

Residual Air Bone Differences in Improved Cases

Post-Op. Air Bone Gap	No of Cases	Per Cent of Improved Cases
0–5 db	8	21.0
6–10 db	7	18.4
11–15 db	4	10.5
16–20 db	3	7.9
over 20 db	16	42.1
Total	38	100.0%
Bone conduction data unavailable		13 cases

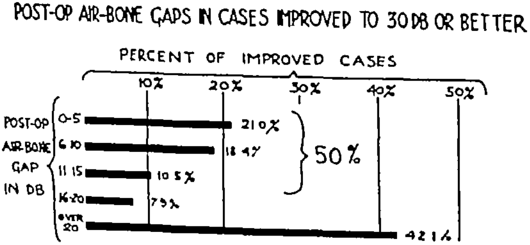

Fig. 14. Residual air bone gaps following successful mobilization in A B and C cases

Will the Hearing Restored by this Technique Last?

Table XI shows the duration of improved hearing for all cases which reached a post-operative level of 35 db or better

TABLE XI.

Duration of Improved Hearing From Mobilization to Most Recent Test

Duration Up to Most Recent Test	No of Improved Patients	Total No Operated
Under 3 months	12	46
3–6 months	24	77
6 months–1 year	14	68
1–2 years	9	13
Over 2 years	2	2
Total	61	206
No follow-up		5
Improved then regressed to pre-op level		2

Two additional patients who showed improvement by hearing tests following the operation subsequently returned to the pre-operative level within two months One other patient's hearing regressed from a post-operative level of 15 db to 30 db 17 months after operation

These results indicate that in all but three cases showing audiometric gain up to the 35 db level or better, the hearing improvement has been mainted for periods up to and exceeding two and one-half years

Is the Hearing Made Worse by Mobilization?

In none of the unimproved cases did the hearing fall more than 10 db below the pre-operative level by pure tone and speech audiometry

What are the Indications for This New Procedure?

At present it can be stated that all patients with progressive conductive deafness in whom the history, physical and audiological examinations indicate a fixed stapedial footplate due to otosclerosis are suitable for mobilization Also mobilization is indicated in the early cases of otosclerosis in which the hearing loss is less than 30 db The hearing loss in such patients is not great enough to derive the benefits of fenestration or the hearing aid In addition, mobilization seems indicated in cases of profound hearing loss due to long-standing otosclerosis In these cases the goal of mobilization is one of rehabilitation of the patient with or without a hearing aid

What are the Significant Features of This Technique?

This is a minor operation and a short one The surgical shock is almost nil Following the operation the patient may have his regular meals, is ambulatory, leaves the hospital the following morning, and may go back to work in a few days Surgical after-care consists only in removing the dressing covering the ear on the fourth or fifth post-operative day In about two weeks after the operation the skin of the canal is healed and the drum, which has been red and swollen, begins to take on its normal appearance There is no post-operative vertigo or any disequilibrium In many cases the tinnitus disappears the instant the footplate is mobilized Patients are allowed to swim, dive, travel by air, etc., without restriction

Are There Complications?

In five cases suppuration of the middle ear occurred shortly after the operation and resolved Three of these followed an upper respiratory infection The hearing in four of the five cases did not improve In one the hearing ultimately reached the 20 db level, which has been maintained for 14 months to date A perforation of the drum has persisted in one patient.

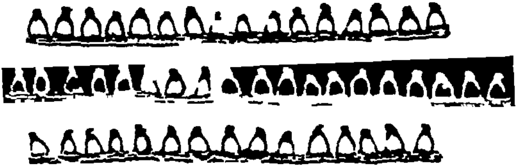

Fig 15 Fifty stapes removed from fresh cadavers with the footplate completely fixed in cement. Despite the wide variation in structure and thickness of the crura firm pressure on the head and neck produced no motion whatever Note the differences in the thickness of the crura Relatively few have very thin crura.

Of the 211 cases, none showed any evidence of labyrinthitis facial paresis, erysipelas or perichondritis In a small number the drum was perforated during the operation but healed within ten days

Upper respiratory infection shortly after operation depresses the hearing markedly and should be avoided

What Surgical and Technical Factors Contribute to Success or Failure?

The most important element in the success or failure of the operation is the degree of fixation of the stapedial footplate and the thickness of the crura (see Fig 15) Success of

Two additional patients who showed improvement by hearing tests following the operation subsequently returned to the pre-operative level within two months One other patient's hearing regressed from a post-operative level of 15 db to 30 db 17 months after operation

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2 *Age at Time of Operation* There does not appear to be significant differences between the improved and unimproved groups within each category with regard to age The average age of patients in the *C* and *D* categories, who by definition showed more cochlear involvement was greater than those in Class *A* and Class *B* Within each category, therefore, the age of the patient is apparently unrelated to success or failure of the operation

3 *Duration of Deafness Prior to Surgery* In this series there appears to be significant differences between the improved and unimproved groups, particularly in the *A* and *C* categories, in the length of time deafness was reported by the patient to have existed prior to the operation The history of deafness was of longer duration in the unimproved group in each category In the unimproved group there is usually greater fixation of the footplate of the stapes, which is more difficult to mobilize, however, there are notable exceptions Sometimes in patients with a shorter history of deafness the rigidity of the footplate does not permit its mobilization and at other times in patients with a long history of deafness the footplate can be mobilized, as shown by the ranges in Tables XII

TABLE XII

Duration of Deafness Prior to Operation (In Years)

Category	A		B		C		D		All Cases	
	Av	Rge	Av	Rge.	Av	Rge	Av	Rge	Av	Rge
Improved Cases	8 8	1–26	11 4	2–28	10 0	1–20	15 0	3–26	11 1	1–26
Unimproved Cases	13 1	2–28	12 6	1–3[illegible]	17 4	8–45	16 4	3–31	14 7	1–45

the operation occurs when pressure on the neck of the stapes fractures the otosclerotic bone responsible for the ankylosis, thus allowing the footplate to move freely Failure to improve the hearing occurs when the otosclerotic bony mass causes such a great degree of stapedial fixation that the crura fractures, leaving the immovable footplate The mobilizer must exert its pressure only on the neck of the stapes, which is thick and strong Even very light pressure of the mobilizer just below the neck will cause a crural fracture at once, in which case a fixed footplate, which might have been mobilized, is left behind

The muscles involved in the actual pull of the mobilizer against the neck of the stapes are the small muscles of the fingers and hand, never the larger muscles of the elbow or shoulder

Some of the pitfalls in this operation should be mentioned In the beginning, because of the bulge of the bony canal wall, it is difficult to separate the skin and lift the drum out of its sulcus anteriorly without tearing either the skin or the drum. In some cases the incus and stapes are completely hidden by the posterior bony canal wall The edge of the bony canal wall must, therefore, be removed cautiously to expose the ossicles Care must be taken not to separate the incudo-stapedial joint during the mobilization Care must also be exercised not to dislocate the footplate of the stapes by too sudden and too great pressure against the neck Again, it is well to discover these pitfalls on the cadaver

What Other Factors Contribute to Success or Failure?

In addition to the surgical aspects, other evidence was studied to determine why some patients benefit from this procedure while others do not

1 *Pre-operative Hearing Tests* There did not appear to be significant differences between the improved and unim

proved groups within each of the *A*, *B* and *C* categories in the following respects *a* Pre-operative average air conduction thresholds (500-2000 cps), *b* Average bone conduction thresholds (500-2000 cps), *c* Bone Threshold at 2000 cps, *d* air bone gaps (average of 500 2000 cps as well as at 2000 cps alone), *e* Speech reception thresholds, and *f* Discrimination scores

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Category	A		B		C		D		All Cases	
	Av	Rge	Av	Rge	Av	Rge	Av	Rge.	Av	Rge
Improved Cases	8.8	1-25	11.4	2-28	10.0	1-20	15.0	3-26	11.1	1-26
Unimproved Cases	13.1	2-28	12.6	1-32	17.4	3-45	16.4	3-31	14.7	1-45

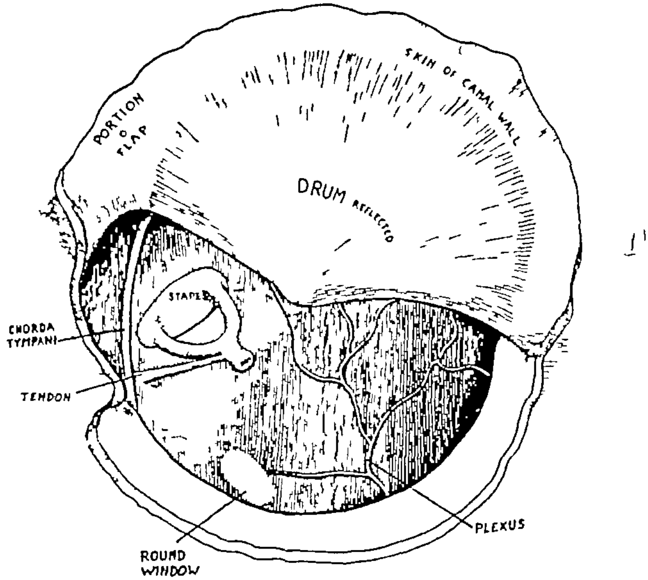
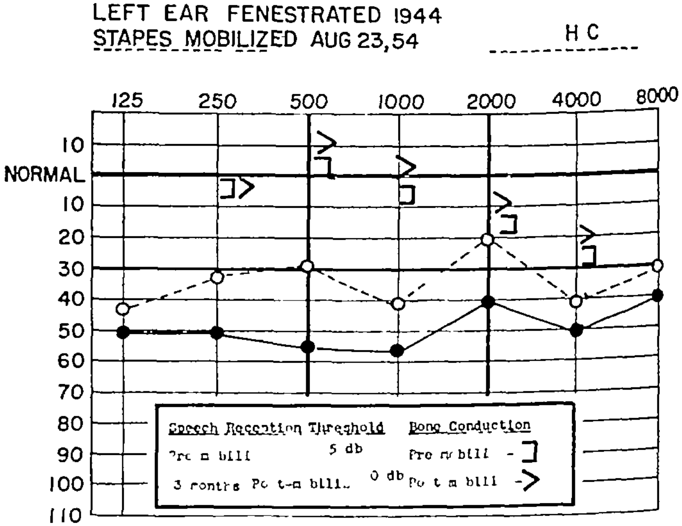


Fig 16 Drum skin of canal wall and portion of skin flap made at fenestration are lifted upward The stapes can be seen in its entirety Stapes is then mobilized as in non-fenestrated cases



Case 4 H C Left Ear The solid line indicates air conduction audiogram taken just before mobilization of the stapes This ear has been fenestrated unsuccessfully in 1944 The dashed line shows the air conduction audiogram for the same ear three months after mobilization of the stapes The speech reception thresholds and pre-and post mobilization bone conduction thresholds are also shown

Can Improved Hearing Result from the Fenestration Operation on the Side in Which the Rigid Footplate Could Not be Mobilized?

In a presentation to the Audiological Congress in Paris, in January, 1955,[21] Dr Werth of Israel, trained by Cawthorne of London, reported that in the past two years he has had success in 14 out of 16 fenestration operations performed on ears after unsuccessful mobilization His results in these cases showed that of the 14 successful fenestrations, seven are better and seven worse than the Shambaugh[7] prediction, the average improvement was 28 db as against 26 db pre dicted These fenestration results are similar to those obtained in virgin ears Werth found no special difficulties in performing fenestration in these cases A few others have reported to the author sucessful fenestration results after unsuccessful mobilization

Can Improved Hearing Result from the Mobilization of the Fixed Stapedial Footplate on the Side in Which the Fenestration Operation has Failed?

The following case, H C, is of special interest because hearing was restored by mobilizing the fixed footplate of the stapes in the ear which was unsuccessfully fenestrated

This 50-year-old housewife had a left fenestration operation performed ten years ago Since the fenestration, the hearing in this ear had fallen to 50 db in the speech frequencies The operative cavity was healed The fenestra was closed osteogenetically, since repeated mechanical irritation all around the fenestral site failed to evoke any vestibular reaction In August, 1954, the mobilization technique was used in elevating the drum and skin. About 6 to 8 millimeters of the lower portion of the skin flap made at the fenestration was also elevated along with the above The incus of course had been removed at the time of the fenestration operation The stapes was thus exposed in its entirety (see Fig 10) It was found rigid on palpation and was mobilized The hearing improved and has been maintained (See Audiogram, Case 4)

DISCUSSION

No discussion of a new surgical procedure for otosclerotic deafness should fail to mention the great contributions of Holmgren, Sourdille and particularly Lempert, in the development of the very effective fenestration operation The present work is a natural consequence in the quest for a simpler procedure. We are all indebted to Dr Lempert for his pioneer work in the surgery of otosclerosis The interest which he stimulated in our field has been a challenge to all of us to search always for additional techniques of treating deafness Were it not for his contribution to otology this technique of mobilization might not have been developed

Stapes mobilization, stapedectomy and other operations in the middle ear to improve hearing date back to the latter part of the last century The operations were performed mostly through a myringotomy opening, or after removal of all or part of the drum, however, all of these operations were abandoned 50 years ago

In the present technique, instead of myringotomy, the lower half of the intact drum is lifted out of its sulcus and folded upward upon itself, as Lempert did in his tympanosympathectomy operation This gives a wider exposure of the middle ear than myringotomy but does not expose the stapes sufficiently, therefore, enough of the edge of the posterior bony canal wall is removed to bring the important structures into clear view, without which precise mobilization of the stapes cannot be safely performed This, together with the specially devised instruments, represents a new technique of stapes mobilization

Since the ossicular chain is preserved in the mobilization operation it is possible to restore hearing to the limits of the cochlear potential No other treatment can do this today

The patient with early otosclerosis whose deafness is not yet severe enough for fenestration seems to have an opportunity for achieving normal hearing by mobiliaztion

It is surprising from the histo-pathological point of view that the fractured otosclerotic bone does not begin to heal at once and ankylose the stapes footplate again All but three of the successfully mobilized cases have maintained their hearing improvement, indicating that the footplate is still mobile The otosclerotic focus may contain the kind of bone which when fractured does not heal, as fractures through the labyrinthine capsule frequently do not heal

It is not intended to make any comparison between fenestration and the author's experience with the mobilization operation This report introduces a new technique of stapes

mobilization as an *additional* surgical tool for otosclerotic deafness

It has been shown that fenestration can restore hearing in an unsuccessfully mobilized ear, and mobilization can restore hearing in an ear unsuccessfully fenestrated It is indeed fortunate that the two procedures can complement one another It is realized, moreover, that it must be satisfactorily demonstrated in a large series of cases that a sufficient number of patients in whom mobilization failed can be successfully fenestrated If the number of successful mobilizations, plus the number of successful fenestrations in mobilization failures, approaches or exceeds the percentage of success of fenestration alone then patients with otosclerosis can be offered the mobilization operation first. The next step in this work is the study to determine the success with which mobilization failures can be successfully fenestrated

It is hoped that interest in mobilization of the stapes will lead to further refinements and additions in technique with even greater benefits to those afflicted with deafness.

SUMMARY AND CONCLUSIONS

1 A new technique is described for the restoration of hearing by mobilizing the fixed footplate of the stapes in otosclerosis.

2 One of the major features of this operation, which permits the physiological restoration of a normal conducting mechanism, is that it can improve hearing to the limit of the cochlear potential as measured by bone conduction

3 Results in 211 cases operated between April 1952 and August, 1954, are statistically analyzed

4 In Class *A* cases (maximum pre-operative loss of 10 db by bone conduction in the speech frequencies) 52 per cent achieved pure tone levels of hearing between normal and 35 db and 64 per cent reached these levels by speech audiometry In Class *A* cases 48 per cent reached the 30 db level or better by both pure tones and speech audiometry In this group two patients achieved hearing within nomal limits in the speech range.

5 In Class *B* cases (maximum pre-operative loss of 20 db by bone conduction in the speech frequencies) 89 3 per cent stimulated in our field has been a challenge to all of us to search always for additional techniques of treating deafness. Were it not for his contribution to otology this technique of mobilization might not have been developed

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opportunities for surgical restoration of hearing 1, mobilization of the fixed footplate and 2, fenestration

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achieved pure tone levels of hearing between normal and 35 db and 41.4 per cent reached these levels by speech audiometry. In Class *B* cases 32 per cent reached the 30 db level or better by pure tones while 34 per cent reached this level by speech audiometry. In this group five patients achieved hearing within normal limits in the speech range.

6. In Class *C* cases (maximum pre-operative loss of 30 db by bone conduction in the speech frequencies) 26.6 per cent achieved pure tone levels of hearing between normal and 35 db and 28.5 per cent reached these levels by speech audiometry. In this category 16 per cent reached the 30 db level or better by pure tones while 21 per cent reached this level by speech audiometry.

7. When the percentages of improved patients in the categories most suitable for mobilization (*A* and *B*) are combined in accordance with the number in each category, 42 per cent reached pure tone levels between normal and 35 db (46 per cent by speech audiometry), while 36 per cent achieved a hearing level between normal and 30 db. If the percentages of improved patients in the *C* category (generally less suitable) are added to those of *A* and *B*, 37 per cent reached levels of 35 db or better by pure tones and 40 per cent by speech, while 30 per cent reached a level of 30 db or better by pure tones and 32 per cent by speech audiometry.

8. A total of seven patients obtained a post-operative hearing level within normal limits (less than 10 db loss).

9. In none of the unsuccessful cases did the hearing fall significantly below the pre-operative level.

10. Patients with early otosclerosis with a hearing loss of 30 db or less may be ideal for mobilization, since the hearing loss is not great enough for fenestration.

11. Successful mobilization may contribute to the auditory rehabilitation of a patient with severe otosclerotic deafness when the conductive element is reduced or eliminated.

12. A case is presented showing that mobilization of the fixed stapedial footplate restored hearing in an ear previously fenestrated without success.

13. A patient with otosclerotic deafness now has two opportunities for surgical restoration of hearing *1*, mobilization of the fixed footplate and *2*, fenestration

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DISCUSSION

JOSEPH L GOLDMAN, M D (New York, N Y) Realizing our responsibility in this work, it was decided last September to conduct an independent study on private as well as service cases admitted to the Mount Sinai Hospital for the mobilization operation Since then 55 private patients, all belonging to Dr Rosen, and five service patients, were admitted to the hospital Two audiograms were made preoperatively on each patient by an audiologic technician, and two follow-up audiograms were made about two months or more after the operation

It was not intended to report this investigation until the complete data had been gathered, however, I am making this premature and preliminary report so that all available information from our hospital records can be presented to you

So far there have been 22 follow-up examinations on the private patients and five follow-up examinations on the service cases, making a total of 27

Of the 27 patients who have been seen post-operatively, nine, or 33 per cent, reached the 30 db level in the three critical speech frequencies and 13, or 48 per cent, reached the 35 db level

The tympanic membrane was found intact in every case, slightly retracted in six, and markedly retracted in one case

In my estimation there appear to be two main issues in relation to this work first, there is the question of whether the results obtained from the mobilization operation will last Obviously time alone can answer this question, second, there is need to determine if mobilization failures can be fenestrated successfully in a large series of cases If this phase of the problem can be carried out successfully, and if results from mobilization of the stapes persist, then I believe that the mobilization operation will deserve to be considered as an additional surgical method in the treatment of otosclerosis

RICHARD J BELLUCI, M D (New York, N Y) My experience with the operation for mobilization of the stapes extends over a period of almost one year as the first case was performed at the Manhattan Eye Ear and Throat Hospital on April 16 1954 The cases selected were satisfactory material for the fenestration operation and satisfied the following criteria

1 All cases had more than 35 db loss by air conduction

2 Most cases had very good bone conduction a few had a drop in the higher frequencies but would be considered good cases for the fenestration operation

3 All had negative Rinne for 512 and 1024

4 All had positive paracusis.

As a preliminary study attention was directed toward

1 Determining whether the stapes, once mobilized would allow improvement in hearing to the serviceable level

2 How often could an improvement in hearing be expected in a given group of cases on which the mobilization operation was attempted

3 How long would the improvement in hearing last

Analysis of results found cases falling into four groups

1 Unquestionably better hearing from the standpoint of the patient and confirmed by audiometric studies — 28 per cent.

2 Questionable improvement in hearing Patient heard slightly better the first day or in the operating room but either did not maintain this improvement or the improvement could not be confirmed by audiometric studies — 22 per cent

3 Improvement which was satisfactory immediately postoperative and followed by regression to the preoperative level of hearing — 6 per cent.

4 Mobilized but no improvement — 4 per cent.

It is difficult to make any definite conclusion from this small group of cases which have been observed for such a short period of time however, we may develop a general impression from this work and thus direct a particular line of thinking We can make the following statements at this time from this work

1 We found that the stapes can be mobilized in about 60 per cent of the cases.

2 Under ideal conditions a satisfactory improvement of hearing above 30 db can be expected in one of four patients attempted

3 A rather large group of patients although ideal candidates, who apparently had a successful mobilization of the stapes did not obtain the improvement expected Further study is required to determine the cause of failure

4 In this series three patients lost the initial improvement in hearing in 4 to 6 weeks. The others who experienced the improvement, having survived the initial 4 to 6 weeks did not seem to deteriorate in the subsequent period of observation These patients however must withstand the test of time before we can call them rehabilitated

52 per cent with an improvement to the 35 db level or better It is our opinion that a patient who is ideally suited for fenestration deserves to have the fenestration operation performed rather than this relatively uncertain procedure

Dr Rosen brings up the point that the patient can have a fenestration if his procedure is unsuccessful, and that the mobilization maneuver will not produce a further improvement in hearing

We have done only 14 of these operations, following Dr Rosen's technique as closely as possible This was a patient (slide) who was not suitable for fenestration On the left hand audiogram you see the air conduction curve, the solid line and the bone conduction curve Because the patient was not suitable for fenestration the mobilization procedure was suggested, and the patient accepted On the right hand side you see the result one week after operation a very definite further loss in hearing due to serous labyrinthitis Whether this will recover or not we do not know, but it is possible to get temporary, at least, labyrinthine damage from this procedure

This was the patient (slide) ideally suited for fenestration Notice the very excellent air bone gap On the left side you see the air curve, between 50 and 60 db loss, and the bone curve within the normal limit, a case of complete stapes fixation The usual fenestration operation was performed without incident, and no bleeding into the fenestra The Rosen maneuver was then carried out on the stapes The stapes suddenly became mobile, a moment later profuse bleeding began to issue from deep within the labyrinth It was coming from the region of the stapes foot plate I am sure that I inadvertently luxated the stapes footplate in the labyrinth Notice this patient's hearing test two weeks after fenestration and mobilization, a further loss undoubtedly due to the labyrinthine damage I do not think that this procedure is a completely harmless procedure I believe there will be cases of labyrinthine damage, and that this must be taken into account in advising the procedure for patients

Again we must stress the psychology of the patient who has had an unsuccessful mobilization Many of these patients were highly suited for fenestration and will refuse to submit to a second procedure They tried surgery and failed They are through, and they will be deprived of the possibility of restoration of practical hearing from this fact We have done 14 of these operations to date, a very small series I am sure that our technique is far from perfect, although I had the opportunity of having learned this technique from Dr Rosen We have only four results that were good, which I consider a very disappointing batting average, and these are our initial results It is now five and one-half months wherein the hearing improvement was as good or perhaps a little better than the results of fenestration would have been

Finally, the technique of this procedure is not easy, do not be deluded. To me it is as difficult, possibly more difficult, because I have done fewer of these cases than fenestrations

Victor Goodhill, M D (Los Angeles, Calif) The discussion of this paper both pro and con resembles very closely some of the discussions reported in the *Boston Medical and Surgical Journal* in the early 1890s, and they make very fascinating reading

This stapes approach to stapedio-vestibular ankylosis is not in its infancy but rather in its second childhood My interest is dual

A What is the pathologic physiology of lysis or liberation of stapedial vestibular fixation? Perhaps the word "ankylosis" is not the very best term to use here.

B If such fixation can be surgically relieved, what long term changes might be expected?

I am prepared to discuss only "A" because my experience with "B" is too short to warrant any opinion as to the future of this operation, as far as the patient is concerned therefore in showing my cases, if I may, I should like to stress the fact that I am reporting only the immediate post-operative results. In working with this problem my technique has varied in some respects from the techniques described by Jack Miot, Sieberman and Rosen I should like to emphasize what Dr Shambaugh said The technique is not easy

I would like to emphasize the difference in my technique First of all, the incision is a larger one and collar shaped.

Second, I find that frequently I have to employ a burr to expose sufficient bone to be able to observe the incudo-stapedial joint adequately

Third, in most cases I have found the use of the microscope of great value in that it has revealed to me that many so-called mobilizations, so-called fractures of the crura, were not done by the surgeon, although I did plenty, but were present as the result of disease. It is possible to see that the footplate has long ago disappeared and been replaced by osteogenetic bone in the fenestra ovalis.

Fourth, and perhaps most important, I have found that in many instances I could not tell whether or not I could mobilize the stapes by the responses of the patient to my whispered voice I found that frequently I was too enthusiastic spoke loudly to the patient, and was quite happy when he heard me. I found it possible to employ operative audiometry which is possible on the table, and which has given me a very valuable help in detecting when apparently slight displacement will produce improvement in hearing

Fifth the displacement of the fixed footplate I found to be very difficult to perform by motion applied to the stapedial neck itself In many cases I found it was very easy to dislocate the incudo-stapedial plate by this technique. Consequently I found I could avoid such dislocations more frequently by applying force through the incus itself in the direction of the incudo-stapedial joint.

Sixth, I found that I could not tell by digital palpation techniques what I was accomplishing I frequently was too ambitious in digital pressure, and so I have been using a controlled pressure by a microvibrator attached to the dental engine particularly in cases of marked fixation.

Seven, I have tried to preserve the chorda tendinea wherever possible.

Eight, I have occasionally sacrificed the stapedial tendon in order to obtain mobility

This (slide) will show the technique of operative audiometry where we do a reading after the drum has been opened and then replaced, so that the drum is closed We test the hearing by pure tones on the operating table with a sterile sheet interposed between the ear phone and the ear, and we test it by responses of the threshold to four frequencies, 500 through 4,000 We then test when the drum is open and the middle ear is exposed and then when we have applied some force to the incudo-stapedial joint. If the test at that point shows a significant improvement

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This slide is the exposure that can be obtained There are some errors of course in the relationships here, but again this kind of exposure can be obtained with much less trauma and with much less postoperative inflammatory reaction I do think that the stapes mobilization technique is one which eventually will take a place in our treatment of deafness. How much of a place it will take remains to be seen

HOWARD P HOUSE, M D (Los Angeles Calif) This has indeed been a very illuminating discussion and I think the Council of this Society is to be complimented on presenting this subject here I had the pleasure of visiting Dr Rosen last September and observing his work I certainly compliment him on his technique. It amazed me the small amount of discomfort these patients show They go through the procedure with practically no discomfort whatsoever in spite of a gram and one-half of seconal the spectacular improvement began at the time of surgery and the cases that I was able to see post-operatively were indeed most illuminating

I have confined all of my cases to date to the opposite ear in previously fenestrated cases which have been successfully fenestrated on the one side. I have done so because of the psychological problem which I was going to mention but which has already been amply covered It has been my experience that once you have fenestrated successfully on one side patients are very happy, even though you may get a failure with mobilization on the opposite side. It also offers a wonderful comparison between the two sides in a single individual As far as my results are concerned, we have had but 22 cases to date I might say that five of those 22 did obtain adequate hearing equivalent to that obtained on the opposite side, that three additional cases gained improvement but not to the serviceable level The remainder were plus or minus five db essentially the same, except for one in which there was a 10 db drop by air conduction This obviously is far too early to discuss or analyze such a small series.

In one case I fenestrated the patient whom I unsuccessfully attempted to mobilize. The only interesting factor is that the flap was exceedingly thick. It was my pleasure to have Dr Day with me on that occasion, the thickness of the flap was troublesome at the time and I was concerned as to what might happen subsequently I was delighted that after six weeks the patient's audiogram showed improved hearing equivalent to the opposite ear At the present time the flap although still thick apparently because of scar tissue, is certainly functioning very adequately

I certainly agree that mobilization is a difficult procedure. I should not like the idea that it is a simple procedure to get around the country side, and I agree that it should not be done by anyone who is not equipped to carry right on through with the fenestration if the occasion subsequently becomes necessary I think that further improvements in the technique and the passage of time will provide the answer to the final role of mobilization in otologic surgery

I compliment Dr Rosen not only for his excellent presentation today, but also for focusing our thoughts toward mobilization at this time

THEODORE E WALSH M D (St. Louis, Mo) I do not want to say anything against the concept of reactivating *mobilization* *It* proved in hearing we close the middle ear, and then test the hearing for the fourth time We will just show the one on operative audiometry As you will notice in this illustration with the middle ear closed — 55, 70, 50 and 60, with the middle ear open drop — 75, 65, 55 Very strangely, as noted in many instances, there was an improvement at 4,000 cycles without doing anything to the incudo With the stapes mobilized a definite improvement, when compared with the middle ear — 60, 50, 45 and 35, and with the middle ear closed — 35, 35, 35, 20, which is in marked contrast to the middle ear closed, at first, and in this patient postoperatively, you will notice a change in air threshold, as computed by the Fletcher formula of 25, in contrast to 45, to 500, 30 and 45, 20 to 40 and 50, and 30

Slide No 4 will show immediate results in the so-called good candidates, in which I have classified the candidates as having bone conduction levels of 20 db Here I will not belabor all these cases, but I would like to show that there is a significant number that are worse It is true that most of them are not worse by any great degree Some of them, however, are worse by as many as 15 db in the speech frequencies. In this group there were 41 per cent that had improvement up to or better than the satisfactory level commonly accepted in fenestration surgery, between 25 and 30 db in the speech frequencies Six per cent had only a partial gain, not significant, 18 per cent were unchanged, and 33 per cent were definitely worse.

This group is the experimental group (slide) of poor candidates, who would never be acceptable for fenestration surgery, and in my opinion are not patients for mobilization These had bone conduction of less than 40 None of them reached the practical level although they did obtain improvement

This last slide is the most interesting of the group, in that these are the so-called poor candidates with bone conduction between 20 and 40 db. In this group we have the largest number of elevations of threshold to practical level — 60 per cent reached it, 14 per cent were partially improved, 14 per cent improved, and seven worse I should like to emphasize that these are primary results and not at all follow up studies. I conclude my feeling about this procedure by saying that this is an interesting and essential approach to the study of the surgical physiology of otosclerosis, stapedial vestibular fixation Its future as a rehabilitation measure must be determined by further study

CLAIR M KOS, M D (Iowa City, Iowa) My experience has been limited to 63 cases of stapes mobilization and those that achieved what we call practicable or serviceable results were 18, or about 28 per cent.

I am a little surprised at the emphasis that is being placed upon the suitability of these patients for mobilization as compared to the suitability for fenestration In other words, I believe the impression has been left that those who are ideally suitable for fenestration are also ideally suitable for stapes mobilization That has not been my experience, that is, in the group in which the stapes is mobilized with the greatest of difficulty, if mobilized at all, the percentage of the results which are successful has been the lowest The results have been best in those of the early cases, clinical otosclerosis which are not yet suitable for fenestration surgery, and among those there is the highest incidence of regression, again presumably because the otosclerotic process may be still in its spongy or vascular stage The higher incidence of successes has been in those which have been classified as unsuitable for fenestration surgery because of superimposed inner ear involvement, in which presumably the otosclerotic process has become matured and ischemic or sclerotic

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Theodore E Walsh M D (St. Louis Mo) I do not want to say anything against the concept of reactivating mobilization. It proved useless in the past, maybe there is a change in technique. I do disagree, however, with Dr Rosen in his presentation of this condition in his attempt to give us results I must admit that I was completely misled by the percentages I am not clear yet as to what his results are in the 200 and more cases he has done I know he has a few cases who have been done for two or three years with good results, but how many have failed? I still do not know We have done 16 cases, and we find that out of the 16, a total of six which have been rehabilitated I mean by that who have had good results for both pure tone audiograms and the speech tests We have had two that have had a slight improvement but not worth while, and seven that have definitely failed There is one case that has lost 20 db for speech, and two others that have gone down between 5 and 10 db, so it is not without some danger, I believe Regarding the question of which cases are suitable, I do not agree with Dr Rosen that anybody who is suitable for fenestration is suitable for mobilization. Those cases in which the mobilization will fail because of cracking of the crura can be fenestrated very successfully, and they have been done. I have one in this series I cracked his crura in my attempt at mobilization I then did a fenestration on his other ear, and he had an excellent result

KENNETH M DAY, M D (Pittsburgh, Pa) It has been said that there is nothing new under the sun Remember that similar procedures were discarded at the turn of the century

I am going to make a few quotes from Dr Jack, in 1893 "I do not think that the results of operation in sclerosis are at all encouraging Mobilization of the stapes gives results for a few weeks and then adhesions reform and the trouble returns "

Dr Gleason in 1898, A M A "12 cases, 5 a noticeable and practical improvement of hearing In one of which improvement lasted for 3 years, then lost Most showed improvement for a few weeks " Then a comment, "Hearing might have been again improved by remobilization "

Dr Miot reported 74 good results of 126 cases

Dr Sieberman, in 1900, at the American Otological Society "All attempts at mobilization of the stapes are not only useless, but often harmful "

In 1903, Dr Jack presented a case of good hearing in both ears ten years following stapedectomy There was a question from the floor "How many operations in past year " Answer "none," by Dr Jack

Dr Politzer, 1894, referring to Miot, reported that Miot had 20 good results in 54 operations for otosclerosis He said "One may conclude that a permanent result is possible only in cases in which adhesions are torn by the manipulation "

Remember that this must be considered as still an experimental procedure Long term results are not important There were two main questions, will the improved hearing be maintained? Will the hearing be made worse?

I shall close with a quotation from Virgil "timeo Danaos et dona ferentes " If you do not know the translation, look it up

SAMUEL ROSEN, M D (New York, N Y) Well, first of all I thank Dr Joseph Goldman for his remarks He has been very helpful to me, and I have cooperated with him in the study that we are making on the cases that I am doing independently at Mount Sinai Hospital

Unfortunately I did not quite understand all of what Dr Lempert said, so I am not sure that I can answer some of his questions but I will make an effort to do so In the first place I do not want to give the impression because I do not have this feeling at all nor have I ever had it that mobilization is going to replace or is to replace, or is a substitute for fenestration The two procedures at the present time cannot be compared

Fenestration started in 1938 and it has taken a long time for fenestration to reach the excellence in technique and understanding that we now have. I do not know why everybody expects that this technique, in a year and one-half or two years of concentrated experience is going to measure up to fenestration This is a simple procedure, it is not an easy one, but once you learn it is very easy to do and I say that if any patient has a chance of having his hearing restored by this simple procedure having it done this afternoon going home tomorrow morning without any post-operative treatment without having to go back to the doctor often for any reason at all and can go back to work in a few days, and if it is done by a skillful surgeon the patient has nothing to lose I do not understand why the stapedial footplate does not reankylose This has bothered me since the first time that I mobilized a stapes and I did not do the second one for a while because I was waiting for the first one to become ankylosed again I do not understand it During the operation, for the most part we do not see the footplate of the stapes We move the neck and the patient hears and we do not know what goes on down below, and until we do know, if I said anything I would not know actually what I was talking about.

If I understand correctly Dr Lempert said that this two-featured technique which he is trying now employs the mobilization first and in the event it does not work he goes right on with the fenestration

DR. LEMPERT That is not correct.

DR. ROSEN Would you mind setting me correct?

DR. LEMPERT I devised this technique to try to find out how often I can mobilize the stapes, and if I can not I can continue immediately on the table to do my fenestration on the same ear not on the other ear

DR. ROSEN The same ear?

DR. LEMPERT On the same ear

DR. ROSEN You try to mobilize that stapes?

DR. LEMPERT Yes.

DR. ROSEN What do you do if you succeed?

DR. LEMPERT I succeeded in seven out of fifty

DR. ROSEN What did you do in the seven?

DR. LEMPERT I was only investigating this problem I am interested in studying this problem.

DR. ROSEN Was it necessary in the successfully mobilized seven cases to fenestrate them?

DR. LEMPERT Absolutely!

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Dr Rosen Those are not the figures, Dr Lempert

Dr. Lempert Those are the figures that I got from the Manhattan Eye and Ear, one in four That was told to the patients

Dr Rosen 29 per cent in the second place I will now read you the percentage of the cases that I showed on the screen in A-cases, the number of patients who reached a 30 db level was 48 per cent, in the B-cases 32 per cent, in the C-cases 16 per cent

Now for the rest, I think that Dr Lempert will surely come up with something very good soon, because I know this has gotten under his skin a bit, and I am sure he will come up with something a lot better

Dr. Lempert If I had the time I would have shown slides

Dr Rosen Again

Dr Lempert May I ask you a question, not a personal talk between us?

Dr Rosen I want to answer the rest of the questions Again I reiterate that the mobilization is no substitute for fenestration, and it is not intended to be

I agree with Dr Kos that time will tell We have to wait with this thing Nobody really knows the result The results that I have I find encouraging, and regardless of what anybody thinks I am going to go ahead and mobilize until the cows come home, I am going to do my best to get better results, improve my technique just as the evolution of fenestration has gone ahead, and so I hope and expect that this will happen also in the mobilization

As for the past, it is true that Miot and Bucheron and Sieberman and all the rest of the men who did this operation before stopped doing it. Why did they stop doing it? I cannot find a reference anywhere in the literature as to the reason for which they stopped, and so I have to wonder why would I stop if I were doing what they did, and the most logical answer, as far as I am concerned, is that they did not have an adequate view through a myringotomy I do not believe that this procedure can be done adequately in most cases through a myringotomy I think it is dangerous to do it that way That may be the reason why Sieberman said that it not only was useless but harmful, among other things.

Dr Shambaugh's remarks were very interesting Most of these remarks were made in the dark, as far as I was concerned, and I cannot read my writing The slides were being shown, and I was trying to make notes as to what everybody said and I cannot read part of it. At any rate there is a similarity between fenestration and mobilization in that the hearing always goes down after mobilization as it does after fenestration, but the reason for it is altogether different The Rinne remains negative all throughout post-mobilization period until, if that stapes was mobilized, the hearing comes up and then it becomes positive. I do not believe what happens in two weeks has anything to do with labyrinthine irritation I think it would be a mistake to get the idea that any labyrinthine irritation occurs after mobilization I have not seen one case of vertigo after mobilization In the reports of others who tried mobilization they do not speak of labyrinthitis I do not believe it is There surely is no proof of it

Now Dr Goodhill's remarks are very interesting He is very ingenious. He is already doing things that I thought I should be doing and I hope he keeps on doing them and gets some information for everybody

Audiometry in the operating room, we have tried, our setup isn't too good as yet, but I think that we will try to better it.

What encourages me is not why it was abandoned, but when men like House Kos, Shambaugh Goldman Walsh and Bellucci say "Now I have tried this operation. I do not know what its future is going to be, and I am not sure what happens, but I have tried it, and some of these patients are hearing very well" I think that is enough for all of us to try a simple innocuous procedure.

I thank Dr Day Dr Nash and the Society for giving me this opportunity to present this work This really is a happy day for me, and I thank you very much.

SOUTH CAROLINA SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

Plans have been completed for a joint meeting of the North Carolina Eye, Ear, Nose and Throat Society and the South Carolina Society of Ophthalmology and Otolaryngology at Columbia S C, on September 12, 13, and 14, 1955 Headquarters will be the Columbia Hotel

The following ophthalmologists will be on the program Dr E W D Norton of New York, Dr Frank Carroll of New York, and Dr William B Clark of New Orleans

An announcement of three guest otolaryngologists will be made later

A most attractive program has been arranged For further information address Roderick Macdonald, M.D, Secretary and Treasurer, 330 East Main Street, Rock Hill, S C

COURSE IN RHINOPLASTY, RECONSTRUCTIVE SURGERY OF NASAL SEPTUM AND OTOPLASTY

An intensive postgraduate course in Rhinoplasty, Reconstructive Surgery of the Nasal Septum and Otoplasty will be given July 16, 1955, to July 30, 1955, by Dr Irving B Goldman and staff at The Mount Sinai Hospital New York City, in affiliation with Columbia University

Candidates should apply to Registrar for Postgraduate Medical Instruction, The Mount Sinai Hospital, 5th Avenue and 100th Street, New York 29 New York.

WOODEN FOREIGN BODIES IN THE PARANASAL SINUSES

MERRILL LINEBACK, M D,
Atlanta, Ga

The unusual circumstances in the acquiring of vegetable foreign bodies in the antra are deemed of sufficient interest to warrant reporting the two following cases The importance of anaerobic cultures and sensitivity testing in the bacteriological handling of infection is emphasized The possibility of tumor, either benign or malignant, is suggested when only one sinus is involved To the differential diagnosis of single sinus affection must now be added the possibility of presence of a foreign body of the non-opaque variety, especially if nothing suggests it in the X-ray

CASE REPORTS

Case 1 Mr T S S, while serving as a revenue agent for the government was assigned the case of a North Georgia moonshiner in September of 1935 During the course of a chase in attempting to bring the culprit to justice the latter took off through a hardwood 'thicket' common in the Georgia foothills and the agent had to bend forward almost double in order to negotiate the low lying branches He did not get very far,

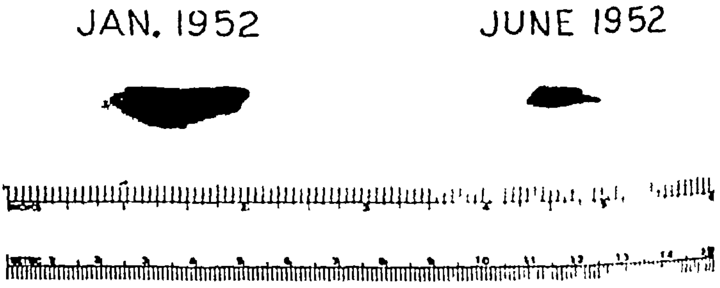

Fig 1 The two pieces of wood blown from the nose of Case 1

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for the next thing he remembered was waking up in a small town practitioner's office with a twig sticking out of his left eye He stated that this was pulled out and the cut eyelids sutured No damage ensued to the eye itself

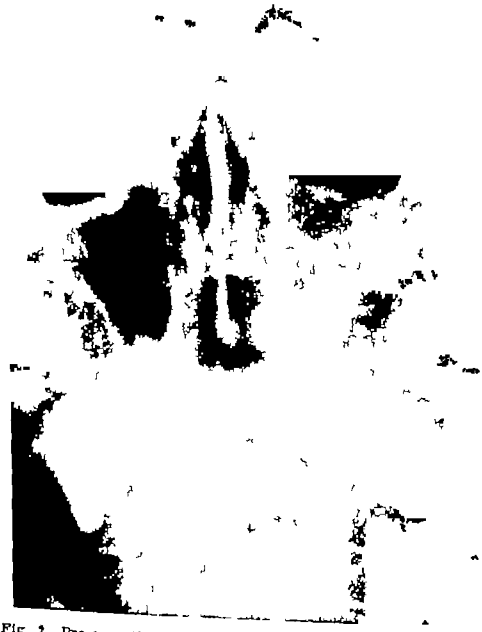
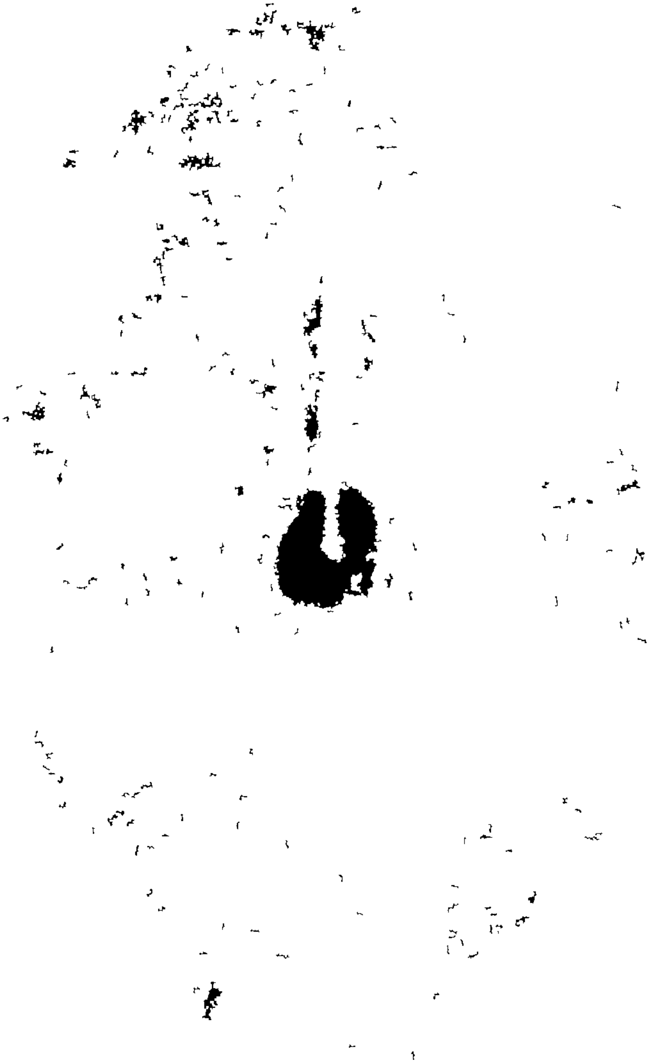


Fig 2 Pre operative X ray of Case Showing only the left antrum diffusely cloudy No foreign body can be detected.

Until 1943 he remained symptom free and in the Fall of that year began to have headaches for which he was checked by his dentist, who found the teeth in good shape

He consulted his physician in Alabama, in 1945 who after X rays revealed pus in the left antrum suggested that he undergo an operation



but the agent declined In January and again in June of 1952 he blew some pieces of wood out of the left side of his nose (see Fig 1) He was X rayed and again advised to undergo left Caldwell Luc for removal of a large foreign body that apparently had been in the left antrum for 17 years He again declined

Case 2 Mr H R P., a 33-year-old refrigeration expert had spent what he termed "two fortunes" for penicillin "shots in a vain attempt to clear up his left maxillary sinusitis He related how he d seen practically every physician east of the Mississippi River and still had his infection It was suggested that the only remaining avenue to investigate was a direct view of the left antrum at operation X rays (see Fig. 2) revealed that the left maxillary antrum only was involved in suppuration and in this respect a primary tumor either benign or possibly malignant was conjectured He was admitted to the hospital, where a left antrum aspiration revealed pus which on culture proved to be a pneumococcus that was resistant to penicillin but was sensitive to tetracycline A week of this drug and redrainage of the left antrum still showed pus indicating that the lining membrane was non functioning and that a Caldwell-Luc was next to be done. Lipiodol injected into the left antrum revealed thickened membrane (see Fig. 3)

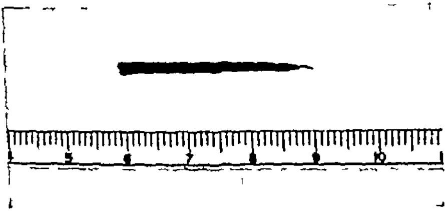


Fig 4 Foreign body of Case 2.

At operation on March 31 1954 halfway through the procedure the Green's forceps pulled out what was at first thought to be a toothpick (see Fig. 4) While the operation was completed curiosity and conjecture ran high at to how such a foreign body could get inside the antrum.

When the patient was sufficiently awake he recalled that at the age of five years, 28 years previously he was "poaching" some succulent but forbidden pears in his grandfather's orchard in Worcester Mass He was using a broken broom handle and throwing it up to knock down the fruit. He remembered that one time it hit his face end-on and "hurt quite a bit," but he never mentioned the incident for fear of punishment. Close inspection of the left cheek revealed a small dimple in the left naso-labial fold at about the level of the intra-antral position of the foreign body

Post-operatively he was back at work within a month To date March 1955 he has had no more complaints referable to his sinuses

DISCUSSION

Metallic substances and glass particles are the usual, if rare

Fig 3 Post-lipiodol injection into the left antrum of C
merely thickened lining membrane and still noth
as a foreign body

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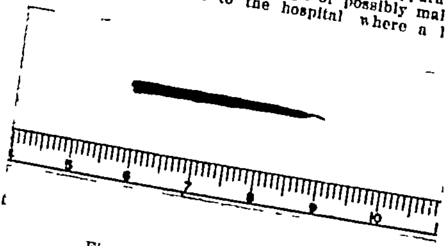

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Post-operatively he was back at work within a month To date March 1955 he has had no more complaints referable to his sinuses

DISCUSSION

Metallic substances and glass particles are the usual if rare bodies, that lodge in the sinuses They are propelled more often into the maxillary sinuses by explosives or during the course of automobile accidents and the like The recent World Wars have given numerous instances of rifle, pistol or shrapnel missiles that usually completely penetrate the involved sinus Rarely do these objects remain in the cavity, being spent if such is the case

Even more unusual is the presence of non-radio-opaque vegetable foreign matter in the sinuses, and in Case 2, the relatively long period of time (28 years) the piece of wood had remained within the sinus itself without causing symptoms Kelemen[1] in 1945 presented a case of spontaneous expulsion of a wooden foreign body from the nose after being present for 28 years What is so remarkable about Case 2 is that the presence of a foreign body was unsuspected until operation was performed

Emphasis needs to be placed upon thorough history taking and study of the individual case The patient in all likelihood, as in Case 2, may have completely forgotten the particular incident involving a foreign body, and much valuable time can be wasted in treating a sinus thought to be merely chronically infected when in reality, foreign matter is at the root of the condition

A further differential point is to be considered when only one sinus apparently is involved a primary tumor, either malignant or benign, is a strong probability in the absence of other sinus involvement This can be ruled out easily with biopsy, and in view of Case 2, a foreign body of vegetable nature should be carefully searched for at the same time

SUMMARY

1 Two unusual foreign bodies involving the left maxillary antrum are presented, one having been present for 17 years, the other for 28 years

2 Being vegetable matter they did not show up on X-ray examination

3 Each patient was symptom-free until his case presented as a "sinusitis" and the usual antibiotic of the time (penicillin) proved to be of no avail

4 Bacteriological examination of one case proved that the causative organism was resistant to penicillin, but on sensitivity testing was amenable to Achromycin-Tetracycline It cannot be too strongly urged that sterile technique and culturing with anerobic procedure be routine when one is dealing with a micro-aerophilic space, such as an infected antrum

5 A single involved sinus should make one suspect something out of the ordinary, such as either a tumor, or in view of these two cases, the presence of a foreign body, especially if the X ray examination is negative for an opaque substance

6 The foreign body in Case 2 gave no evidence of spontaneous expulsion The patient conceivably would never have known of the object had he not been subjected to Caldwell-Luc

7 Adequate anamnesis is absolutely essential

I express my thanks to Dr Scott L Tarplee of Atlanta, Ga, for his referral of Case 1 to me and to Mr John S Goings of Decatur, Ga., for making the photographs

REFERENCE.

1 Kelemen George Spontaneous Expulsion of a Foreign Body by Transmigration Through the Nasal Wall after Twenty-eight Years. The Laryngoscope, 55 3-7 July 1945

28 Eighth Street, N E

TRACHEOSTOMY SCAR REVISION

H CLINTON DAVIS, M D ,
BENJAMIN MUSSER, M D ,*
and
L G GLASSON, M D ,
Miami, Fla

The ever-increasing use of tracheostomy as an adjunct in medicine and surgery, and the resulting lives saved, has made the physician more aware of the typical secondary intention scar deformities (see Figs 1, 2, 3, 4) Often the operation is performed hastily for life-saving reasons without thought of cosmetic planning When tracheostomy is used in conjunction with other surgery, its role becomes secondary, and little attention is directed toward the esthetic outcome Even after the most careful execution of the operation the result is frequently spoiled by keloid formation (see Fig 1), widening of the scar centrally (see Fig 2), and by adherence of the skin and platysma to the deep fascia and trachea The latter problem causes an upward angulation of the wound on deglutition (see Fig 3), while the former exhibits constant deformity Surgical considerations with regard to the revision of these cicatricial lesions will serve as the basis of this discussion

The patient will generally seek the physician's help because *of the unsightly scar, or because of a sense of tugging* with each swallow Occasionally he may volunteer that the contour of an elevated keloid scar interferes with shaving

Surgical correction is directed toward complete excision of the scar with reapproximation of the skin margins in the transverse manner whenever possible When the vertical component of the scar is too great, a modified T-type repair will

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* Dr Musser is now located at Hahnemann Hospital Philadelphia

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generally bring the deformity below the collar level (see Fig 4) Tension on the skin flaps should be minimal Frequently wide undermining of the cutaneo-platysmal layer is necessary to mobilize sufficient skin for a satisfactory closure Delicate handling of tissue and plastic technique are essential for optimal results

Fig 1 Vertical scar with keloid change

Tracheostomy scar revision is a hospital procedure The operation is always an elective one and should be performed in the good risk patient only Endotracheal general anesthesia is strongly advised The patient is positioned on the operating table in the supine position with 2 small pillows beneath the shoulders, as in the method for thyroid surgery Skin preparation and draping are carried out in the routine manner Protective wound towels on the incisional margins are avoided

In planning the scar revision the cutaneous margins should be fashioned in such a way that the wound will have a gentle, upward, lateral curve This will pose no problem if the original incision is of the transverse variety, however, if it is of the vertical type, the elipse of skin to be excised must have more curve on its inferior margin in the conversion to a transverse scar

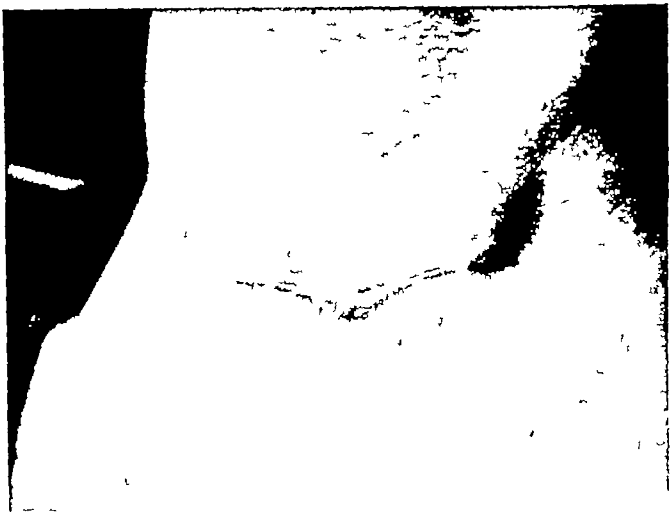

Fig 2 Horizontal scar with keloid change.

The incision is made through the skin, subcutaneous fat and platysma muscle to the underlying fascial layer Here the dissection can be extended in all directions in a near bloodless plane Special care is necessary to locate and avoid injury to the anterior jugular veins because of possible air embolism The external jugular veins are usually too lateral to be traumatized In some instances it may be imperative to mobilize the superior skin flap to the hyoid bone, the inferior wound margin can be freed for a considerable distance over the anterior thorax

Diastasis of the ribbon muscles at the site of the tracheostomy frequently results in adherence between the platysma muscle and the trachea This problem is corrected by mobili zation and reapproximation of the sternohyoid muscle at the site of separation

After the anesthetist removes the shoulder pillow the platysma muscle is closed as a separate layer with interrupted sutures of fine cotton or silk. The skin is then sutured with 4 0 or 5-0 silk, or fine stainless steel wire No drains are used. Hemostasis should be absolute before closing the wound

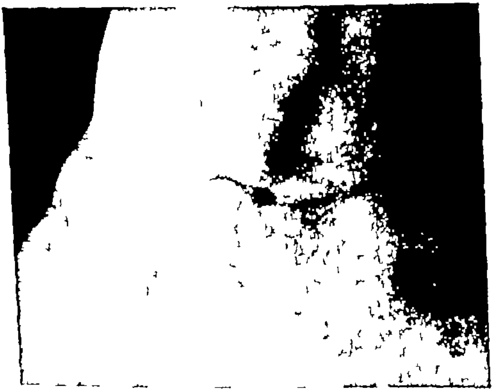

Fig. 1 Adherence of platysma muscle to trachea with deformity of deglutition in the central portion of the wound

Gentle even pressure is applied to the external dressing by the use of sterile mechanic's waste Cutaneous sutures are removed within four to five days Wound margins are then supported by external tape splints for an additional eight to ten days

The results of tracheostomy scar revision are usually gratifying to both the patient and the surgeon Occasionally during the follow up period one may observe stretching of the scar in its midportion (the point of greatest tension) A secondary revision may be required Individuals with a tendency to keloid formation should receive a course of X-ray therapy in

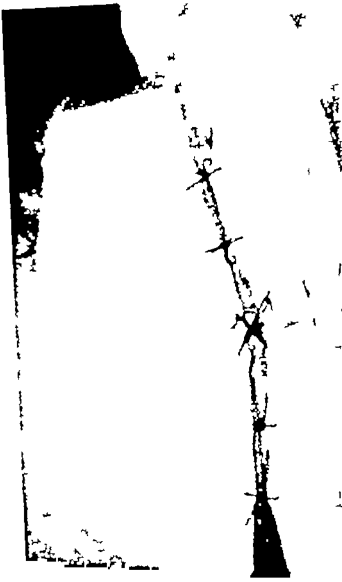

Fig 4 T-type repair of concave deformity following emergency tracheotomy many years before

he immediate postrevision period Time will frequently improve the adherent type of deformity, so revision should be delayed to give nature a chance

SUMMARY

The several varieties of common tracheostomy scar deformities are presented Their surgical correction is discussed

939 duPont Building

UNIVERSITY OF ILLINOIS ANNUAL ASSEMBLY IN OTOLARYNGOLOGY

The Department of Otolaryngology, University of Illinois College of Medicine, announces its Annual Assembly of Otolaryngology from September 19 through October 1, 1955 This Assembly will consist of two parts

Part I — September 19 through September 24, 1955, will be devoted to surgical anatomy of the head and neck, fundamental principles of neck surgery and histopathology of the ear, nose and throat. This week will be under the personal direction of Maurice F Snitman, M D

Part II — September 26 through October 1, 1955, will be devoted entirely to lectures and panel discussion of advancements in otolaryngology The chairman of this section will be Emaneul M Skolnik, M D

Registration is optional for one or both weeks For further information, address Dr Francis L Lederer, 1858 West Polk St., Chicago 13, Ill

POST-GRADUATE COURSES AT TEMPLE UNIVERSITY

The following Post-Graduate Courses to be given in this Department during the current year

Post-Graduate Course in Broncho-Esophagology, June 13-24, 1955, October 17 - 28, 1955

Post-Graduate Course in Laryngology and Laryngeal Surgery, September 19 - 30, 1955

These courses are all to be given in the Department of Laryngology and Broncho-esophagology, Temple University Hospital and School of Medicine, under the direction of Dr Chevalier L Jackson and Dr Charles M Norris The tuition fee for each course is $250 00 Further information and application blanks can be obtained from Dr Chevalier L Jackson, 3401 N Broad Street, Philadelphia 40, Pennsylvania

BRONCHOESOPHAGOLOGY COURSE

The next Bronchoesophagology Course to be given by the University of Illinois College of Medicine is scheduled for the period October 24 to November 5, 1955, under the direction of Dr Paul H Holinger

Interested registrants will please write directly to the Department of Otolaryngology, University of Illinois College of Medicine, 1853 West Polk Street, Chicago 12, Illinois

NEW YORK EYE AND EAR INFIRMARY ALUMNI ASSOCIATION DINNER

A subscription dinner honoring Edgar B Burchell, D.Sc. on the completion of 60 years of distinguished service at the New York Eye and Ear Infirmary, will be given on June 10, 1955, at the 7th Regiment Mess, 643 Park Avenue, at 67th Street, New York City Cocktails and reception at 6 30, dinner at 7 30 P M For further information write to Dr Joseph H Krug, Secretary-Treasurer, Alumni Association, New York Eye and Ear Infirmary, 218 Second Avenue, New York City

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(Secretaries of the various societies are requested to keep this information up to date)

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Meeting Mount Royal Hotel Montreal Canada, May 11 12 1956

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Executive Secretary Dr Chevalier L Jackson, 1901 Walnut St, Philadelphia 3, Pa, U S A
Meeting Fifth Pan American Congress of Oto-Rhino-Laryngology and Broncho-Esophagology
President Dr J H. Font, Medical Arts Bldg, San Juan, P R.
Time and Place 1956, Puerto Rico

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Meeting Statler Hotel, Washington, D C, May 5-10, 1957

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A HISTOCHEMICAL STUDY OF THE COCHLEA*†

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and

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Chicago, Ill

Recently new methods have been used to obtain further information on the microscopic structure of the labyrinth The dissecting microscope and the phase contrast microscope have been used by De Vries[1] (1949) and Hilding[2] (1952) for the study of the origin and insertion of the tectorial membrane, and by Katsuki and Covell[3] (1953) and Engström and Wersäll[4] (1953) for an analysis of the finer cell structure of the organ of Corti The electron microscope was employed by Engström and Wersäll[5] (1953) in their study of the sensory cells, supporting cells and nerve endings. The preparation of the tissue by freezing and drying has been employed by Vilstrup[6] (1950), who examined the cupula and the subcupular space of the cod. By means of ultraviolet microscopy, Hamberger and Hydén[7] (1945) carried out investigations on nuclear and cytochemical changes of the cochlear nerve cells Histochemical methods showed selective staining of the otolithic membranes the cupulae and the tectorial membrane (Wislocki and Ladman[8] 1954) Radioactive sulfur (S^{35}) injected in rats, was detected by autoradiography in the cupula, the tectorial membrane and the otolithic membrane of the utricle[9] (Belanger 1953)

This paper reports histochemical studies of the cochlear duct of the bat after freezing and drying (Gersh[10,11] 1932, 1948, Gersh and Stephenson[12] 1954) The bat was found very suitable for

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such studies for several reasons 1, The internal ear is readily removed with great rapidity and is of such small size as to be very well fixed by freezing and drying Were the structure larger, the ice crystals which form during the freezing would be too large, and disruptive to the delicate structures, for detailed cytological analysis 2, The bony plates of the os petrosum are so thin in the bat that it is possible to cut thin paraffin sections of the internal ear without decalcification It is further possible to cut polyethelene glycol-embedded sections with the freezing microtome for demonstration of lipids 3, The rapidity of fixation reduces to a minimum the post-mortem changes which take place during fixation by immersion in a chemical fixative, or even by perfusion

In addition many effects of the fixatives themselves are avoided by the freezing-drying method employed in this study The methods of fixation usually employed will result in a more or less marked displacement of easily soluble and highly diffusible substances Polysaccharides, proteins, lipids and enzymes are very well preserved by the freezing-drying technique of fixation As the polysaccharide containing proteins of the tissues are preserved with only minimal denaturation by this method, it is possible to make qualitative studies of the solubility of some of these components by the use of various extractives (Gersh and Catchpole,[13] 1949)

Various histochemical staining reactions were employed in this study These included the procedure for polysaccharides, developed by McManus[14] (1946), Lillie[15] (1947) and Hotchkiss[16] (1948), metachromatic staining*, reactions for neutral fat, plasmalogen (a fat with aldehyde groups) and alkaline phosphatase

MATERIALS AND METHODS

Bats (Myotis lucifugus and subspecies) caught in caves during hibernation were used The animals were killed by decapitation. The mandible was removed and the bulla exposed After opening the bulla, the cochlea, with the vestibular apparatus, was easily lifted out This procedure usually took one to two minutes after the death of the animal

The specimen was immediately frozen in isopentane at approximately —155°C, and later dehydrated in vacuo at about —30°C over a period of three to seven days. The tissue was infiltrated with paraffin (m.p 62°C) in vacuo for 15 minutes and embedded For the phosphatase reaction, paraffin with a melting point at 51°C was used. Other specimens were transferred from the vacuum tube to absolute alcohol for one day then to 95 percent alcohol for another day After decalcification in a solution of 0 5 per cent hydrochloric acid in 80 per cent alcohol for about a week they were embedded in celloidin

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* Structures stained with toluidine blue may appear blue or red to purple The former are said to be stained orthochromatically the latter are said to be metachromatic.

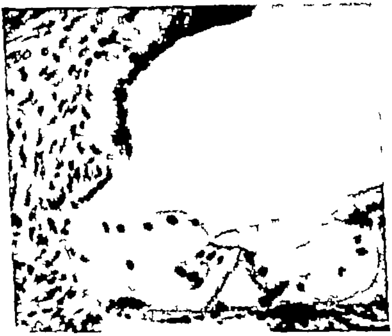

Fig 1 Organ of Corti of the bat. Section prepared by the freezing drying method, stained with hematoxylin-eosin—× 450

Decalcified sections embedded in celloidin were stained with hematoxylin-eosin and by the alcoholic periodic acid leukofuchsin method described by Hotchkiss[16] (1948) Undecalcified, paraffin embedded sections were deparaffinized with xylol or petroleum ether coagulated with absolute alcohol for about 16 hours and stained for glycoproteins after the Hotchkiss procedure. Such sections were used for the study of the total periodic acid leukofuchsin reactive material They were compared with other sections which have been treated before staining with saliva, N/10 hydrochloric acid and various buffers with their respective pH Acetate pH 2 9, 3 2, 4 2, phosphate pH 5 5, 6 0, 7 0, borate pH 8 9

To determine the glycolipid fraction of the total reactive substances sections were deparaffinized in petroleum ether, immersed in equal parts of chloroform and methanol at 60°C for 16 hours, denatured in ethanol for about 16 hours and treated by the

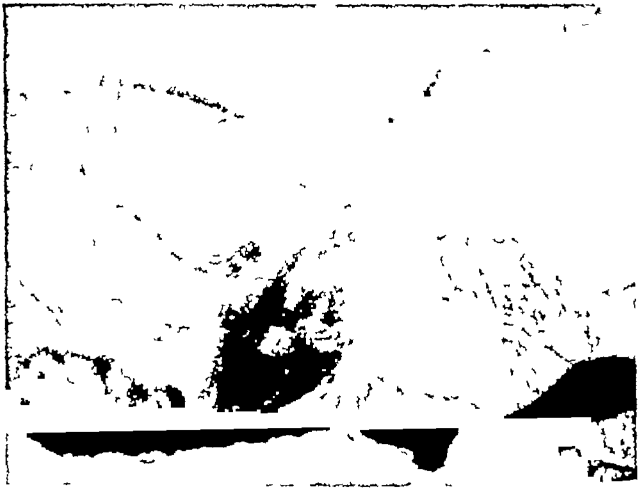

Fig 2 Organ of Corti of the bat Frozen-dried stained by the periodic acid-leukofuchsin method of Hotchkiss—× 1230

The condensed fibers of the basilar membrane are deeply stained. The inner hair cells the Deiters cells and the Böttcher's cells contain Hotchkiss positive material which is extractable by dilute hydrochloric acid various buffers and saliva The surface of the Hensen's cells is covered by Hotchkiss positive filiform processes

Hotchkiss method For metachromatic staining, the paraffin was removed by petroleum ether, and the solvent was allowed to evaporate The sections were covered with a few drops of 0 05 per cent aqueous toluidine blue (pH 5 6) and observed directly

For demonstration of neutral fat and plasmalogen the tissue was prepared according to the method of Hack[17] (1952) The frozen-dried specimens were infiltrated in the vacuum tube with polyethelene glycol "200" for 30 minutes without breaking the vacuum

The tissue was then transferred to "400" polyethelene glycol, and kept at a temperature of 4°C Sections were cut with a freezing microtome Sudan black B was used for the staining of neutral fat The plasmal reaction was carried out as described by Feulgen and Voit[11] (1924)

The calcium phosphate method of Gomori[19] (1939) was applied for demonstration of the sites of alkaline phosphatase activity in the tissue. The slides were incubated for one, three and 12 hours.

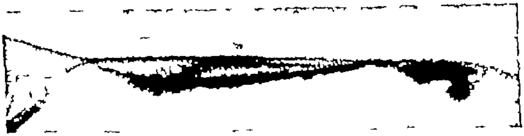

Fig 3 Basilar membrane of the organ of Corti (lower coil) Frozen dried stained by the Hotchkiss method—× 1400

The fibers of the basilar membrane are Hotchkiss positive and embedded in small amounts of interfibrillar substance which is less deeply stained. Both components are not extractable by dilute hydrochloric acid various buffers and saliva.

RESULTS

Membrana basilaris The basilar membrane of the lower coil of the cochlear duct consists of two well defined zones, the inner zone (zona arcuata) and the outer zone (zona pectinata) as seen in Figs. 1 and 3 Radially arranged thick fibers run through both zones. All fibers of the zona pectinata are radially arranged while fibers in the predominant thickening of the zona arcuata run in the direction of the cochlear duct Toward the apex of the cochlea the thickenings of both zones disappear gradually In the upper coil the basilar membrane is thin and consists mainly of radially arranged fibers (See Fig. 4)

All fibers of the basilar membrane were intensely stained by the Hotchkiss method (See Figs. 2 and 3) Small amounts of interfibrillar substance were less deeply stained After treatment with the various extractives no change of stainability of both components of the membrane was noted With toluidine blue the fibers and the ground substance were stained metachromatically reddish purple

The scanty protoplasm of the mesothelial cells on the scala tympani surface of the basilar membrane showed a pink color by the Hotchkiss method

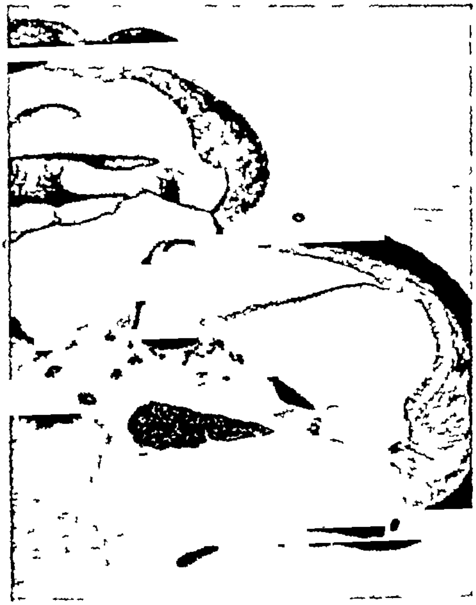

Fig 4 The lower and the upper coil of the cochlear duct of the bat Frozen-dried stained by the Hotchkiss method—X 150

The Deiters cells are more intensely stained in the upper coil Hotchkiss stainable granules in the stria vascularies are more numerous in the upper coil

Ligamentum Spirale, Limbus Spiralis The fibers of the ligamentum spirale and the limbus spiralis were stained deep red after the Hotchkiss procedure (See Figs 4, 5 and 11) The connective tissue cells and the ground substance were stained pink Hydrochloric acid (N/10), the various buffers and saliva did not change the stainability of the connective tissue components When the sections were incubated in a hot chloroform methanol solution

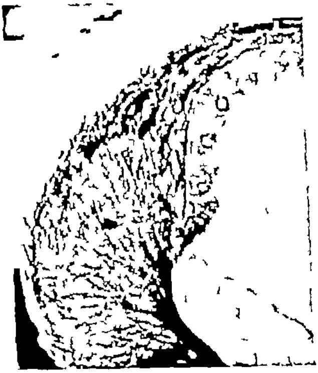

Fig 5. The spiral ligament and the stria vasculares of the cochlear duct of the bat. Frozen-dried stained by the Hotchkiss method—X 425

The connective tissue fibers are intensely stained, the ground substance, the connective tissue cells and the cytoplasm of the stria vascularis reveal a pink color. This Hotchkiss positive material was not affected by dilute hydrochloric acid various buffers and saliva.

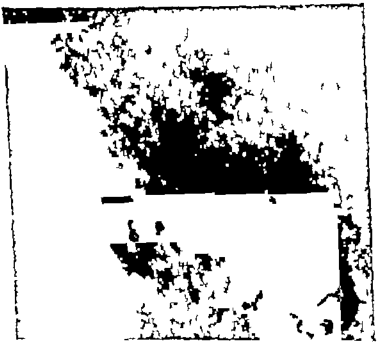

Fig 6. The spiral ligament and the stria vascularis of the cochlear duct of the bat. Frozen dried undecalcified embedded in polyethelene glycol stained for plasmalogen—X 1 5

Plasmalogen is demonstrated in the ground substance and the cells of the spiral ligament, and in the cytoplasm of the stria vascularis. Connective tissue fibers and nuclei are plasmal negative a very slight decrease of stainability of the ground substance was noted The fibrous structure of the ligamentum spirale and the limbus spiralis appeared reddish-purple, the cells and the ground substance more purple after metachromatic staining While the thick fibers were plasmal negative, the ground substance and the connective tissue cells of the ligamentum spirale were plasmal positive (See Fig 6) Comparable components of the limbus spiralis were less intensely stained for plasmal

The "Huschke's teeth", consisting mainly of condensed fibers, stained deep red by the Hotchkiss method (See Figs 7 and 8) The cytoplasm of the epithelial cells of the limbus spiralis, which continue in the inner sulcus cells, did not stain by the Hotchkiss or by the plasmal reaction

The Sensory Cells of the Organ of Corti The outer hair cells with their cuticles were not stained by the Hotchkiss method, toluidine blue for metachromasia, the plasmal or phosphatase reactions. The reticular membrane was also negative, however, the cytoplasm of the inner hair cells revealed a pale pink color by the Hotchkiss method (See Figs 2 and 10) After immersion in chloroform methanol a decrease in stainability was not noted, but the pink Hotchkiss stain could not be observed when the sections were pretreated with N/10 hydrochloric acid, the various buffers and saliva before or after alcoholic denaturation

The cytoplasm of the inner hair cells stained very faintly by the plasmal reaction Metachromasia and alkaline phosphatase activity were not apparent in the inner hair cells

Supporting Cells, Bottcher's Cells, Inner and Outer Sulcus Cells The cytoplasm of the Deiters' and Bottcher's cells stained pink by the Hotchkiss method (See Figs 2 and 10) The stain was more intense in the cells of the upper coil of the cochlear duct (See Fig 4) After treatment with the various extractives the cytoplasm of

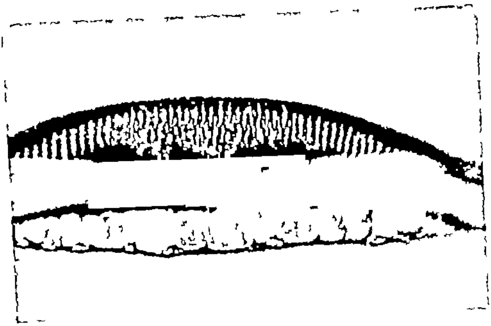

Fig 7 Huschke's teeth of the limbus spiralis (bat) Frozen dried Hotchkiss method—× 300

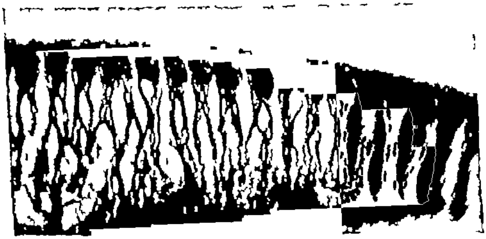

Fig 8 Huschke's teeth of the limbus spiralis (bat) Frozen dried, Hotchkiss method—× 925 Huschke's teeth consist mainly of condensed deeply stained fibers.

these cells could not be stained Metachromasia was not observed in these cells. When Hack's method for plasmalogen was used, the cytoplasm of the Deiters' and Böttcher's cells stained faintly The other supporting cells, as well as the inner and outer sulcus cells, did not exhibit a positive reaction with the histochemical reactions employed in this study The outer sulcus cells in the upper coil

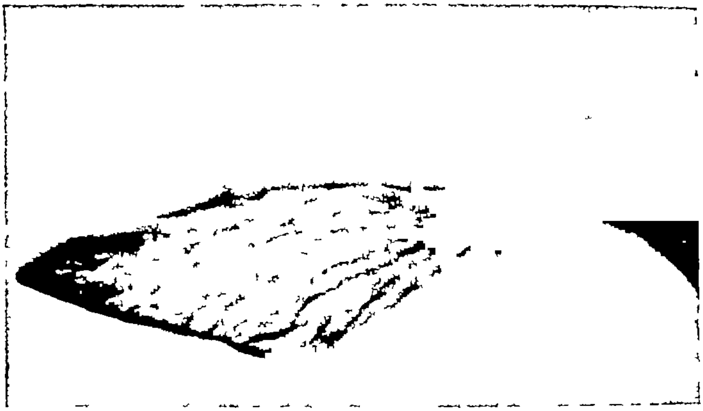

Fig 9 Membrana tectoria (bat) Frozen-dried Hotchkiss method—X 1625

The fibers are intensely stained the interfibrillar substance reveals a pink color The membrane is attached to the vestibular lip of the limbus spiralis by a deeply stained homogenous substance

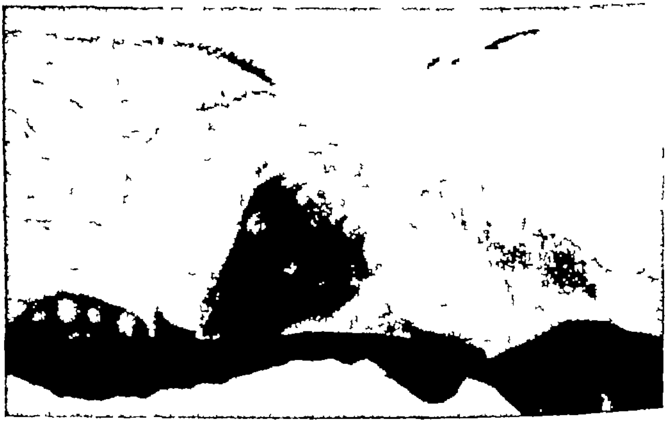

Fig 10 Membrana tectoria (bat) Frozen-dried Hotchkiss method—X 1135

Note marginal network (Randfasernetz) on the upper surface of the membrane and Hotchkiss positive filiform processes on the surface of the Hensen s cells protruded into the connective tissue of the spiral ligament in a few sections (See Fig 15)

Membrana Tectoria The numerous fibers of the tectorial membrane were deeply stained by the Hotchkiss method and were separated by pink staining material (See Fig 9) The various extractives did not alter this pattern of staining The fibers gave an intense metachromatic reaction with toluidine blue (reddish purple), while the material between them appeared purple In contrast to the spiral ligament and the limbus spiralis the interfibrillar material of the tectorial membrane was negative for plasmalogen and was only very faintly stained with eosin

The general direction of the fibers of the membrane is radial to the axis of the cochlea with a marked deviation towards its lower surface. Approaching the lower surface the fibers bend in the radial direction Branches follow the same general direction. The fibers are condensed at the limbal portion of the membrane The limbal portion is attached to the underlying epithelial cells of the limbus by a homogenous material stained red by the *Hotchkiss* method and reddish purple with toluidine blue for metachromasia

The tectorial membrane was attached with its lower surface to the *organ of Corti*. A marginal network ("Randfasernetz" of Deiters) was seen in nearly all sections, and had the same staining qualities as the fibers of the membrane (See Fig 10) It covered mostly one third to one half of the upper surface of the membrane ("upper surface" extending from the outer margin to the vestibular lip of the limbus spiralis) Hotchkiss positive filiform processes with the same staining features as the marginal network were seen on the surface of the Hensen s cells (See Figs. 2 and 10) In some instances a pink reddish stripe covered the surface of the outer sulcus cells and the surface of a layer of two or three inner sulcus cells adjacent to the organ of Corti.

Stria Vascularis The cytoplasm of the stria cells stained pink when the Hotchkiss method was applied (See Fig 11) Hotchkiss positive, very thin threads in the axial direction of the cells were present in the cytoplasm Small granules stained intensely after the Hotchkiss procedure and exhibited metachromasia They were

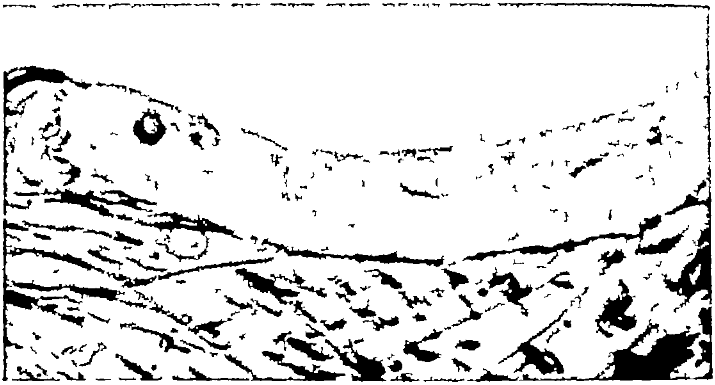

Fig 11 Stria vascularis of the lower coil of the cochlear duct (bat) Frozen-dried Hotchkiss method—X 1035

Only a few Hotchkiss stainable granules are seen in the cytoplasma of the stria cells The fibers in the connective tissue adjacent to the stria vascularis stain deep red

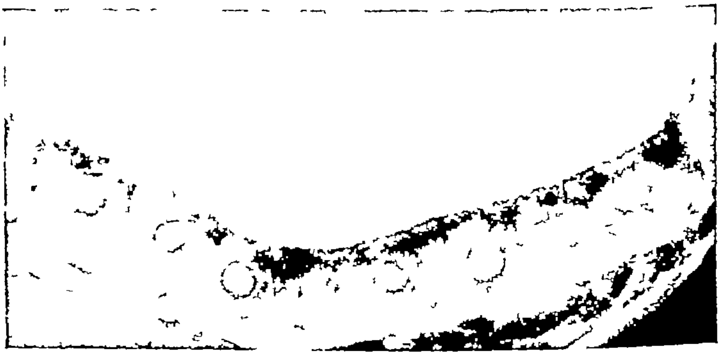

Fig 12 Stria vascularis of the upper coil of the cochlear duct (bat) Frozen-dried Hotchkiss method—X 940

Note aggregations of the Hotchkiss stainable granules close to the upper surface of the cells and the sharply defined basement membranes around the capillaries

visible mostly in the upper half of the cells around the nuclei, which are localized closely under the free surface of the epithelium. The granules were most numerous in the upper coil of the cochlear duct (See Fig 12)

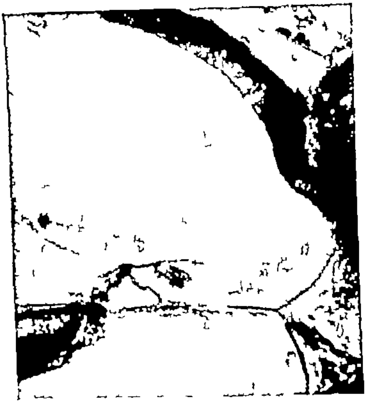

Fig 13 Cochlear duct of the bat Frozen-dried, undecalcified alkaline phosphatase reaction—× 400

Positive phosphatase reaction in the basal part of the stria vascularis adjacent to the connective tissue. In the control without glycerol phosphate the cells of the stria vascularis were unstained

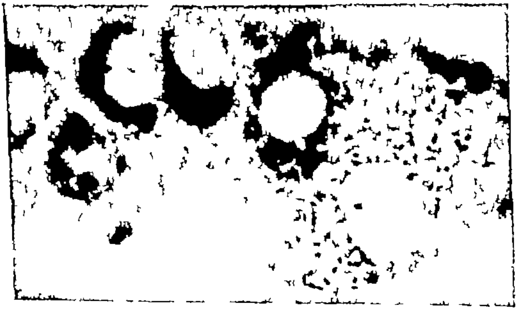

Fig 14 Reissner's membrane (bat) Tangential section Frozen dried Hotchkiss method—× 3450 Numerous minute granules are stained intensely

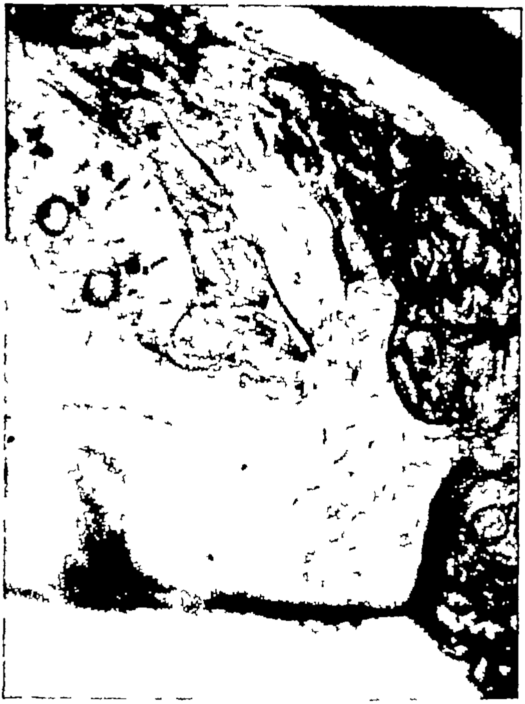

Fig 15 Outer sulcus cells in the upper coil of the cochlear duct (bat) Frozen-dried Hotchkiss method—X 1075

Note pale staining cells protruding in the connective tissue of the spiral ligament.

The Hotchkiss positive material in the stria vascularis was not extractable with dilute hydrochloric acid, the various buffers and saliva The cytoplasm of the cells revealed a rather strong reaction for plasmalogen (See Fig 6) When the alkaline phosphatase reaction was applied, incubation of the slides for one hour, as well as for three and twelve hours, showed a positive reaction in the basal part of the stria vascularis without major changes in its localization during the various incubation periods (See Fig 13)

The Hotchkiss procedure revealed very sharply defined basement membranes around the capillaries of the stria vascularis (See Fig 12) The membranes were not affected by the various extractives. Yellow-brownish pigment granules were found irregularly dis tributed in the stria vascularis. A layer of small epithelial cells between the stria and the Hotchkiss negative outer sulcus cells stained very similar to the stria epithelium

Reissner s Membrane The cytoplasm of the epithelial cells of Reissner s membrane stained pink by the Hotchkiss method (See Figs. 4 and 14) The scanty cytoplasm of the mesothelial cells was similarly stained Numerous minute granules stained intensely red by the periodic acid leukofuchsin reaction and exhibiting metachromasia were found in the cytoplasm of the epithelial cells (See Fig 14) These granules were more frequently seen in the regions of insertion of the membrane After treatment with N/10 hydrochloric acid, the various buffers and saliva, the Hotchkiss positive material in the membrane, did not change in stainability When the plasmal reaction was carried out, the cytoplasm of the epithelial cells stained faintly Small vacuoles of various sizes were occasionally observed in the cytoplasm of the epithelial cells. Lipids were not demonstrated in these cells. Pigment granules similar to those in the stria vascularis were found in varying amounts in the epithelium.

A homogenous basement membrane separating the epithelial cells from the mesothelial cells was intensely stained after the Hotchkiss procedure The stainability was not altered by dilute hydrochloric acid the various buffers and saliva

DISCUSSION

According to Gersh and Catchpole[13] (1949) variations in the consistency of ground substance are responsible for its plasticity The freezing-drying method of fixation permits qualitative studies of the solubility of some glycoprotein components at the microscopic level. When tested with dilute hydrochloric acid and buffers of differing pH, the glycoprotein of the connective tissue of the spiral ligament and the limbus spiralis and of the tectorial and Reissner s membrane was not affected These features indicate that the ground substance is firm and highly aggregated

Certain classes of lipids like kerasin lecithin phosphatide and others may give a positive periodic acid leukofuchsin reaction. (Hack cited by Gersh and Catchpole[13] 1949) There was a slight decrease of stainability of the ground substance in the spiral liga ment and the limbus spiralis after incubation of the sections in a hot chloroform-methanol solution which indicates that some lipids of the varieties mentioned may be present in these sites. The ground substance of these structures was stained by Hack's method for visualizing plasmalogen, indicating the presence of acetal phosphatides of unknown type

The tectorial membrane is described as containing a gelatinous substance of jelly-like nature, rich in water (Kolmer[20] 1927) The specific gravity is relatively low (Hardesty[21] 1915) The Hotchkiss procedure revealed a strongly positive reaction of its fibers, and the interfibrillar substance was stained pink As the stainability was not affected by the extractives, it is suggested that the glycoprotein of the tectorial membrane is highly aggregated. Plasmalogen was not found in the interfibrillar substance of the tectorial membrane In contrast to the spiral ligament and the limbus spiralis eosin stained the ground substance only very slightly These findings indicate a marked difference of the chemical composition between the Hotchkiss positive material of the tectorial membrane and that of the spiral ligament and the limbus spiralis

The experiments of Wislocki and Ladman[8] (1954) did not suggest a sulfated mucopolysaccharide as a component of the tectorial membrane A moderate reaction for protein-bound sulfhydryl and disulfide groups was reported by these authors Bélanger[9] (1953) who injected radioactive sulfur in immature rats, found a high concentration of S^{35} in the tectorial membrane indicating the synthesis of an organic sulfur compound When stained with toluidine blue, metachromasia of the fibers and the interfibrillar substance of the tectorial membrane was observed in our experiments. Until recently metachromasia was believed to be specific for the presence of sulfuric esters of large molecular size Michaelis[22] (1947) proposed that highly polymerized carbohydrates produce metachromatic effects by virtue of their carboxyl groups Bélanger (1953), using immature rats as experimental animals, reported the persistence of metachromasia in the tectorial membrane after incubation of the slides with hyaluronidase

In our study the tectorial membrane was attached with its lower surface to the organ of Corti Its insertion has been the subject of controversial opinions Using phase contrast microscopy De

Vries[1] (1949), Hilding[2] (1952), Katuski and Covell[3] (1953) offered some evidence that the marginal network ("Randfasernetz" of Deiters) usually covers the Hensen's cells but is torn loose during the preparation of the tissue and thrown back on the upper surface of the tectorial membrane Our sections showed that the marginal network and the small filiform processes on the surface of the Hensen's cells had the same staining properties when subjected to the Hotchkiss procedure. This finding may be regarded as support for the opinion that the tectorial membrane is attached to the Hensen's cells in vivo

According to Held[23] (1926), Kolmer[20] (1926) and others the limbal portion of the tectorial membrane is attached to the underlying epithelial cells by a cement substance. This substance has the same staining properties as the marginal network of the membrane and the filiform processes on the Hensen's cells.

The stria vascularis is generally believed to secrete the endolymph, or at least to produce certain substances which pass into the endolymph The close relationship between the epithelial cells and the capillaries suggest a secretory activity Morphological findings (Von Fienandt and Saxén[4] 1936), pharmacological experiments with atoxyl (Miyamoto[25,26] 1931, 1932 Ozeri[7] 1937, Rüedi[28] 1951) and pathological observations in cases of angiosclerotic inner ear degeneration (Saxén[29] 1951) are regarded as support for this assumption

Our study revealed certain histochemical features of the stria vascularis which were quite different from those of other epithelial cells of the cochlear duct In contrast to the Hotchkiss positive material in the Deiters' and Böttcher's cells the substances in the stria cells were not extractable with dilute hydrochloric acid, various buffers and saliva. Hotchkiss stainable granules, revealing metachromasia were more frequently seen in the vicinity of the nuclei localized closely under the free surface and at the surface itself

The most striking difference between the stria cells and the other epithelial cells was apparent when the reaction for alkaline phosphatase was applied. Sites of phosphatase activity were found in the basal part of the stria vascularis. It was not possible to decide if the reactive material was localized only in the small, star like "deeper" cells of the pseudo-stratified stria epithelium (Iwata[20]

1924) The sites of activity were obviously unrelated to the capillaries of the stria, as they were demonstrated in the opposite pole of the epithelium adjacent to the connective tissue of the spiral ligament Connective tissue is known to be involved in the storage and transport of metabolites It may be suggested that phosphate esters passing from the connective tissue into the stria vascularis are hydrolized by the alkaline phosphatase found in the basal part of the stria cells

According to Von Fienandt and Saxén[31] (1936) and Saxen[29] (1951) the cells of the sulcus spiralis externus are partly responsible for the reabsorption of the endolymph and for the removal of breakdown products of the cochlear duct The outer sulcus cells are described as being provided with long protoplasmic processes extending into the connective tissue of the spiral ligament and may function as phagocytic groups (Von Fienandt and Saxen[31] 1936) Only in a few sections were cells similar to those as described by Saxén[29] (1951) seen in the cochlear duct of the bat The histochemical reactions for glycoprotein, plasmalogen and alkaline phosphatase were consistently negative in the outer sulcus cells

Kolmer[32] (1911) and Iwata[33] (1925) assumed a functional difference between the outer and inner hair cells because of their distinct morphological differences The outer hair cells did not stain with histochemical reactions for glycoprotein, plasmalogen, neutral fat and alkaline phosphatase, however, the inner hair cells stained pink by the Hotchkiss method The Hotchkiss stained material was readily extracted with dilute hydrochloric acid, the various buffers and saliva In contrast to the negative finding in the outer hair cells, the cytoplasm of the inner hair cells contained plasmalogen

It has been proposed by Engstrom and Wersäll[34] (1953) that the Deiters' and Hensen's cells may be regarded as a nutritive aid system for the sensory cells of the organ of Corti In contrast to the other supporting cells, only the Deiters' cells stained after the Hotchkiss procedure The solubility tests indicate the presence of a readily soluble glycoprotein or polysaccharide similar to that found in the inner hair cells These substances stained more intensely in the upper coil of the cochlear duct than in the lower coil. Similarly, it is interesting that glycogen found in the stria cells of the human fetus is still visible in the stria epithelium of the upper coil when this substance has already disappeared from the epithelium of the lower coil of the cochlear duct (Kolmer[20] 1926)

Using electron microscopy Engström and Wersäll[21] (1953) described a "rich system of minute filiform processes" on the outer surface of the Hensen's cells and the phalanx of the Deiters' cells. They compared this structure with the striated border of the intestine which is regarded as a highly differentiated resorptive organ The striated border of the intestine, as well as of the proximal tubules of the kidney, exhibits a strong alkaline phosphatase reaction but no phosphatase activity was observed in the surface region of the Hensen's cells in our experiments.

Kolmer[20] (1926) reported globules of neutral fat in the Hensen's cells of some mammals (guinea pig and squirrel) and occasionally in humans Katsuki and Covell[3] (1953) using phase contrast microscopy found highly refractile bodies of varying size in the Hensen's cells of the guinea pig, but the authors doubt that all these globules contain fat In our study the histochemical reaction for neutral fat and plasmalogen was negative in the Hensen's cells of hibernating bats.

The Böttcher's cells revealed the same histochemical reactions as the Deiters' cells. The outer sulcus cells which cover the Böttcher's cells did not exhibit histochemical reactions by methods employed in this study The physiological role of the Böttcher's cells is as yet unknown

In all those epithelial cells revealing a positive Hotchkiss reaction (stria cells, Deiters cells, Böttcher's cells inner hair cells) plasmalogen was found also According to Hack[17] (1925) plasmalogens may be considered as metabolites linked together by low energy bonds These bonds can be broken to release substances which may thereby become available in metabolic processes.

According to Wolff (quoted by Engström and Wersäll[5] 1953) the fibers of the outer pillar cells originate from fibers of the basilar membrane Engström and Wersäll[5] (1953) did not find any connection between the fibers of the pillar cells and those of the basilar membrane using the electron microscope The Hotchkiss method and metachromatic staining revealed a positive reaction of the fibers of the basilar membrane The fibers of the pillar cells, however were negative.

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According to Von Fienandt and Saxén[21] (1936) and Saxen[21] (1951) the cells of the sulcus spiralis externus are partly responsible for the reabsorption of the endolymph and for the removal of breakdown products of the cochlear duct. The outer sulcus cells are described as being provided with long protoplasmic processes extending into the connective tissue of the spiral ligament and may function as phagocytic groups (Von Fienandt and Saxén[21] 1936). Only in a few sections were cells similar to those as described by Saxen[21] (1951) seen in the cochlear duct of the bat. The histochemical reactions for glycoprotein, plasmalogen and alkaline phosphatase were consistently negative in the outer sulcus cells.

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In Reissner's membrane, the membrana propria was described by Gottstein[35] (1872) as separating the epithelial cells from the mesothelial cells In the bat, this membrane is very thin It stained intensely by the Hotchkiss method and was not extractable with dilute hydrochloric acid, various buffers and saliva

Granules apparently containing glycoproteins were seen in varying amounts in the epithelial cells of Reissner's membrane

SUMMARY

1 The cochlea of bats caught during hibernation was found to be suitable for detailed morphological and histochemical study after fixation by freezing and drying The histochemical methods included the Hotchkiss procedure (with solubility tests), metachromasia, and staining procedures for alkaline phosphatase, neutral fat and plasmalogen

2 Connective tissue fibers were deeply stained by the Hotchkiss procedure The ground substance of the basilar membrane, the ligamentum spirale and the limbus spiralis contained very insoluble glycoproteins Plasmalogen was found in the ground substance of the connective tissue of the spiral ligament and the limbus spiralis

3 The outer hair cells of the organ of Corti were not stained by the histochemical methods employed A water-soluble Hotchkiss positive substance and plasmalogen were found in the inner hair cells

4 Compounds apparently similar to those found in the inner hair cells were present in the Deiters' and Bottcher's cells The other supporting cells as well as the inner and outer sulcus cells were on the other hand, negative by the histochemical methods employed

5 The fibers of the tectorial membrane stained deeply with the Hotchkiss method, but no plasmalogen was found there A marginal network reacting histochemically like the fibers of the membrane was seen in nearly all sections Hotchkiss positive filiform processes, with the same staining features as the marginal network and the fibers, were observed on the surface of the Hensen's cells

6 Hotchkiss positive granules exhibiting metachromasia were demonstrated in the pink stained cytoplasm of the stria epithelium The Hotchkiss positive material in the stria cells was not extractable

with N/10 hydrochloric acid, buffers of various pH and saliva The cytoplasm of the cells revealed a positive reaction for plasmalogen Alkaline phosphatase activity was found in the basal part of the stria vascularis.

7 Hotchkiss positive granules exhibiting metachromasia were found in the cytoplasm of the epithelial cells of Reissner s membrane The membrana propria stained intensely by the periodic acid leukofuchsin reaction and was not extractable by the reagents employed

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DIFFUSE EXTERNAL OTITIS PATHOGENESIS AND TREATMENT No 2.*†

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In a previous report[1] based on clinical and pathological data available at that time, a new concept of the pathogenesis of diffuse external otitis was presented On the basis of this concept, certain general and specific principles of therapy were enumerated In the ensuing five years, further pathological and clinical data have accumulated It is my purpose to modify the original concept in view of these developments

An important contribution found in a review of the literature is that of Collins[2] This study described an evaluation of the effect of water, high temperatures and humidity on the skin of the external auditory canal Pertinent observations were made, using human volunteers, on the distribution of eccrine sweat glands around the external ear The author concluded that an accumulation of sweat in the ear canal was probably not a factor in the production of otitis externa in hot climates The works of O'Brien,[3] Shelley,[4] Lobitz[5] and Sulzberger and his associates[6,7] are concerned with the physiology and pathology of sweat glands and have been helpful in formulating our opinions

It is important to appreciate the manner in which the healthy skin of the ear canal functions, in order to understand the pathological changes which occur in diffuse external otitis, therefore, let us examine the anatomy and histology of the external ear For purposes of this presentation, we may consider the external ear as divided into two parts *1* The auricle and the periauricular skin, and *2* The external auditory canal and the tympanic membrane

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The auricle and external auditory canal show great individual variations in size and shape In some cases, the tragus and antitragus form a marked obstruction at the entrance of the ear canal, while the long axes of the two canals form an obtuse angle Some lumina are wide and straight without any constriction and thus allow easy access to fluids, while others are narrow and present curvatures which serve to make the entrance or removal of fluids difficult

The external auditory canal is composed of *a* a cartilaginous canal and *b* a bony canal The cartilaginous canal is pliable and flexible as a result of the structure of the cartilage and the vertical fissures of Santorini in the anterior wall The narrowest part of the ear canal, the isthmus, is formed by the marked convexity of the floor and anterior wall of the osseous canal and lies just medial to the junction of the osseous and cartilaginous portions The canal widens abruptly at the drum to form the sulcus of the tympanic membrane.

The skin of the auricle is provided with a distinct subcutaneous layer on its posterior convex surface only It carries a few small hairs with sebaceous glands of considerable size These are particularly evident in the concha The sweat glands are of the eccrine type, and the largest concentration of these glands is found in the preauricular region and in the postauricular skin along the hairline and down into the mastoid process and neck[2]

The skin lining the cartilaginous portion of the external auditory canal is thicker than that lining the osseous portion, shows very little subcutaneous tissue, and is firmly attached to the perichondrium There is a fairly well marked layer of stratum corneum and definite papillae may be visualized No eccrine glands can be observed in histological preparations[8,9] or in sweating experiments[2,10] The sebaceous glands attached to the hair follicles are exceptionally large, and most of the apocrine glands may be seen draining into the apo-pilo-sebaceous units[9,11] In the osseous canal the skin is thin and adheres to the periosteum There is an absence of papillae, little dermis and no subcutaneous tissue Apocrine and sebaceous glands are rarely found

Let us consider the histology of these epidermal glands The sebaceous glands lie superficial in the dermis and consist of multilobulated grape-like glands, all of them opening through short excretory ducts into the lumen of the hair follicle (follicular canal) The excretory ducts are lined by stratified squamous epithelium, which is continuous with the external root sheath of the hair follicle and with the Malpighian layer of the epidermis Most of the polyhedral cells making up the alveoli of the sebaceous glands are filled with fat droplets As one progresses towards the duct, the nuclei are seen to shrink and then disappear as the cells break down into the fatty detritus which forms the sebum and which ultimately mixes the apocrine secretion and the horny exfoliated protein-like scales in the follicular canal

There is no direct evidence for a secretory innervation of the sebaceous glands at the present time It has been proposed that emotional tensions increase sebaceous gland activity by way of direct nervous stimulation[1] It has been further suggested on the basis of morphological data that the sebaceous glands are supplied by nerves which form a plexus on the basement membrane of the glands, but there is no proof that these unmyelinated fibers actually enter the parenchyma or that they stimulate glandular activity

It has been reported that sebaceous gland activity is influenced by various factors such as the chemical composition of the secretion,[13, 14] atmospheric temperature etc The melting point of sebum is around 30° C at higher temperatures the sebum is liquid, while at low temperatures it is solid and hard When fatty acids prevail in the mixture the melting point is low, it is high when the mixture contains cholesterol and wax alcohols Various investigators[15, 16] have stated that the main factor influencing the spread of sebum is moisture on the skin surface The spread is said to be 140 times greater on moist skin than on dry skin This would permit the sebum to wash away on hot humid days leaving the surface vulnerable to maceration and infection

The apocrine glands are located most abundantly in the skin of the second and third quarters of the external auditory canal and according to von Troltsch[17] extend along the superior wall almost to the tympanic membrane Alzheimer[15] reported a great concentration of apocrine glands both on the superior and inferior walls The apocrine glands develop as outgrowths of the outer sheath of the hair follicles (in contrast to the eccrine sweat glands which develop as direct downward projections from the epidermis) In human ear canals the highest percentage of the apocrine excretory ducts open into the follicular canal while a small percentage of these glands open independently upon the surface of the skin of the ear canal[9 11]

As shown by Shelley and Hurley in observations on axillary apocrine glands,[3 4] apocrine sweat is a milky whitish or grayish, sometimes yellowish secretion, which forms a light colored cone over the poral surface It takes the form of an adherent cap which then spreads over the perifollicular skin in a thin film Autonomic innervation is easily demonstrable After painful stimuli, the local injection of epinephrine, or intense emotional reactions, a droplet may appear after a latent period of 15 seconds or more Once a droplet has been secreted, apocrine function ceases for several hours, and further stimulation is ineffective Apocrine glands do not appear to respond to thermal stimulation

It seems clear that these glands have an important role in washing the more viscid sebum from the hair follicle and mixing with it to form an adherent protective surface coating It is worth emphasizing, as presented by Rothman[12] that the stratum corneum offers little or no barrier to infection since it is perforated by the apo-pilo-sebaceous units and thus allows ready contact between external agents and living cells of the sebaceous and apocrine glands The waxy secretion, when present on the surface and within the follicular canal, interferes with the permeation of noxious agents through the epidermis

With this knowledge of the histology and the physiology of the skin of the ear canal as a basis, let us proceed to a consideration of the pathogenesis of diffuse external otitis In our clinical studies,[19] we have had the opportunity of observing large numbers of normal Air Force and Naval volunteers in hot, humid environments Among these healthy young adults there was a consistent reduction or absence of cerumen in the lumen of the ear canal It is our opinion that the oily sebaceous secretions of the apo-pilo-sebaceous units had been carried away as a result of the low viscosity of the sebum at these temperatures and the rapid spread of the lipids on the very moist skin surfaces This defatting of the skin was facilitated by frequent swimming, diving and under water activity

Another factor in the production of dry, scaly ear canals is the accepted practice among parents of removing ear wax from their children's ears Thus, over-conscientious mothers make a daily ritual of digging at the ear canals This habit is carried over into adulthood and constant digging at ears and removal of the protective wax covering may become a nervous habit practiced by adults even in the absence of an accumulation of ear wax.

It is conceivable that as a result of continued exposure to intense heat and humidity and poor aeration of the ear canal that the skin of the ear canal may show changes such as a shift of the pH toward the alkaline side,[20] marked hyperkeratosis and plugging of the apo-pilo-sebaceous units The unprotected upper layers of the stratum corneum then absorb moisture and become swollen and macerated so that proper cornification does not occur

This is the condition we recognize as the pre-inflammatory stage of external otitis[21] If, at this time, the patient avoids further exposure to high temperatures and humidity and ex periences no further local trauma by water or irritating medications, the hyperkeratosis may disappear in approximately two to three weeks through normal desquamation On the other hand, if before this hyperkeratosis disappears, there is further exposure to high temperature and humidity, or the patient traumatizes the skin surface, the inflammatory state which we call acute external otitis is produced

Biopsies from patients with mild external otitis show vari able hyperkeratosis, acanthosis, inter and intra-cellular edema Moderate keratin plug formations are present in the apo-pilo-sebaceous orifices Changes can be seen in the dermis, which include subepithelial infiltration of leucocytes, dilatation of blood vessels and perivascular infiltrate especially in the superficial dermis

As a result of the severe itching or mild pain seen in the early stages of external otitis, irritating medications are introduced into the ear canal Since the important anti-bacterial and antifungal agents produced by the epidermal glands are not present, rapid growth of fungi and Gram-negative bacilli takes place If the acute process is not controlled, more severe clinical and pathological changes occur [22]

On magnification the orifices of the apo-pilo-sebaceous units may be seen producing the cobblestone effect especially visible on the superior and inferior canal walls The total thickness of the skin is greatly increased by cellular proliferation and edema There is marked acanthosis with broadening and elongation of the rete pegs The stratum corneum shows striking changes with multiple fluid-filled spaces and occasional micro-abscesses Irregularly arranged masses of parakeratotic cells are seen filling the crypts of the hair follicles The dermal changes include marked vascular changes such as reduction or occlusion of vascular lumina Contiguous fibrous tissue shows infiltration with eosinophiles and neutrophiles The infiltrate now becomes superficial and deep, and in some cases dense infiltration of lymphocytes and monocytes are observed around small microabscesses The apocrine glands may be embedded in exudate, and in some cases leucocytes are found within the lumina of the glands The sebaceous glands are surrounded by edema and exudate

As the process progresses, the skin is flooded with infiltrate and superficial and deep microabscesses are produced These are seen to be true collections of leucocytes within the epidermis or in the dermis, which eventually break through the surface barrier Such microabscesses appear grossly as single pustules or papules and are often misdiagnosed as furuncles

Finally as a result of the inflammatory process and the failure to eliminate the obstruction of the ducts, variable degrees of vacuolization and degeneration of the epithelium of the apocrine glands occur Evidence of destruction of the acini of the sweat glands and marked periductal and periacinar fibrosis are found

A reversal of the inflammatory reaction takes place with the institution of oral and topical therapy The superimposed infection is controlled by topical antibiotics The extensive edema of the epidermis is eliminated rapidly by proper local therapy Marked exfoliation of the top layers of the epidermis is followed by a slow return to function of the epidermal glands *The deep infection drains onto the surface of the ear canal*

Unfortunately the destroyed apocrine glands cannot be replaced If a sufficient number of apocrine glands is destroyed the patient becomes susceptible to reinfection whenever the temperature and humidity rise above a given point, and a state of chronic diffuse external otitis may be produced

To recapitulate, although all the pathologic, physiologic, and chemical evidence has not yet been obtained, the following concept of pathogenesis of diffuse external otitis will offer a working hypothesis on which therapy may be based As a result of persistent hot, humid temperatures, changes in the epidermis and dermis of the skin of the ear canal are produced in susceptible individuals which make them vulnerable to infection by Gram-negative bacilli and fungi If recovery does not take place before an additional exposure to a hot, humid environment occurs, the epidermal glands are unable to pour their anti-bacterial and anti fungal secretions onto the surface of the skin, and as a consequence, a surface infection develops If the infection is not brought under control marked histopathologic changes are seen in the epidermis and dermis, particularly around the apocrine glands and the vascular tree

Based on this hypothesis, therapy should accomplish the following *1* Susceptible individuals should use proper prophylactic agents during hot, humid periods, *2* Therapy should consist of early topical treatment in mild conditions and a combination of local and systemic treatment in the more severe states, *3* Therapy then should be soothing and palliative during the mild stage and active and curative in the more severe stages.

A *Mild stage*

1. Remove the patient from the hot, humid environment
2. Irrigate the ear canal with hypertonic saline in order to clean away any keratin plugs, inspissated wax and debris which have collected in the ear canal
3. Apply to the lumen of the ear canal mild astringent, drying solutions, for example, aluminum acetate packs or Burow's solution
4. Use non-irritating vehicles as carriers of therapeutic agents, for example, 5 to 10 per cent boric acid in anhydrous lanolin
5. Apply topically non-irritating antipruritics combined with antibiotics having low index of sensitivity

B *More severe stages*

1. Remove patient from hot, humid environment
2. Prescribe, for oral use, broad-coverage antibiotics
3. When ear canal lumen is sufficiently patent, remove inspissated infected debris from lumen and tympanic sulcus by use of 3 per cent hypertonic saline irrigations and then apply proper topical antibiotics in non-irritating vehicle
4. Insert anhydrous lanolin or glycerin pack for 24 hours to reduce edema of the stratum corneum
5. Continue cleansing treatment until there is evidence of a return of function of the epidermal glands

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ALLERGY IN ITS RELATION TO THE TONSILS AND ADENOIDS *

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Some 20 to 25 years ago, during the heyday of otolaryngologic surgery, it seemed that the mere presence of tonsils and adenoids often was sufficient reason for their removal The slaughter of tonsils and adenoids proceeded at a terrific rate until the pendulum of sound judgment swung back from this radical viewpoint to a more conservative and reasonable attitude, and at the present time most throat surgeons require sound and definite indications before advising the operation

We all know that too frequently the results following tonsillectomy and adenoidectomy are disappointing This has led to accusations by our medical friends that the E N T doctor is too prone to operate, and to doubt in the minds of the laity as to the real value of the operation itself Quite often in advising tonsillectomy and adenoidectomy we are told by the parents that Johnny Jones next door had the same operation a year ago, and still is having the same old trouble This makes it difficult and at times impossible to convince the parents that in the case of their own child the operation is justifiable and necessary for the patient's welfare

No doubt, many of you have seen this picture, shown here on the screen, and I am sure you all know what it represents It appeared in one of the outstanding textbooks on otolaryngology as recently as 1947, and is labeled "The Adenoid Face" I have been unable to find the picture in later texts This suggests the thought that present-day investigators have learned that in addition to hypertrophied adenoids other pathologic conditions also can produce the same facial expression and features

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One of these conditions is nasal allergy Allergic sensitization of the nasal membranes can cause the same facial appearance and the same symptoms as an obstructive adenoid Too frequently the differential diagnosis is missed, thus inviting further criticism by the patient's family and his pediatrician or family doctor An example of this is shown by the following case report.

A girl six years of age was brought to me a year ago with the complaint of frequent head colds persistent cough mucoid and mucopurulent nasal discharge and difficulty in breathing through the nose Her appetite was poor and she was undernourished and underweight. After trying tonics vitamins nose drops and other remedies the child was taken to a throat specialist. After a very brief examination according to the parents he announced that the trouble was all due to an obstructive adenoid and advised adenoidectomy This was done along with removal of the tonsils in the month of May

Soon after the operation the child's condition began to improve and remained quite satisfactory throughout the summer months however the symptoms all returned in October of the same year When I saw the patient three months later she had lost all that she had gained including several pounds of weight and I was told that her condition was no better than it had been before the operation The parents were unhappy disillusioned and bitter in their criticism Almost their first remark was to the effect that they would permit no further experimenting upon their child in the way of surgery

It was not difficult to determine why the results of the operation were so disappointing A strong family background of allergy was revealed by the history of the case, the appearance of the nasal membranes was suggestive the nasal secretion was loaded with eosinophiles and the child was sensitive to house dust The specific sensitization was suggested by skin tests and proved by the relief afforded by hyposensitizing treatment with dust extract

Now it is entirely possible in this case that the tonsils and adenoid eventually should have been removed Certainly the presence of allergy in no wise renders a person immune to disease in the adenoid or tonsils, or in any other organ In most cases however, including the one under discussion, it would seem logical first to attempt to relieve the symptoms by control of the allergy, when present rather than by immediately hustling the patient off to the hospital for an operation Following adequate allergic treatment the patient should be in much better condition for the operation if it is still indicated, and the end results should be more satisfactory

The case just reported is not unique, according to my observation I have seen several similar cases, also, a considerable number of children with nasal allergy are brought to me for tonsillectomy and adenoidectomy with the diagnosis and recommendation for surgery already made by the family doctor Some of these patients need the operation Others are relieved of their symptom by allergic management All of these cases, however, require some diplomacy and tact in explaining to the parents that an operation may not be necessary, due to the presence of another condition which could be responsible for the trouble

This news must be broken to the parents in such a way that their confidence in their family doctor shall not be disturbed I have talked over the situation with those doctors who are kind enough to refer their patients to me, and now instead of suggesting immediate operation they explain the various etiologic factors which might be involved in the case, and instruct the parents to bring the child to me for examination and advice regarding the best way of handling the situation This more conservative attitude promotes better results and better relations for everyone concerned

Another case required entirely different management before satisfactory results were obtained

A boy, seven years of age, was brought to me because of frequent attacks of asthma, present since he was four years old The attacks were milder and much less frequent during the summer months but became more severe in the fall of the year Throughout the autumn and winter months he had many head colds frequently associated with sore throat which seemed to precipitate the attacks of asthma He had a personal and family background of allergy and was sensitive to a number of foods and inhalants

I have seen many children with asthma, associated with nasal allergy, who secured relief from the asthma by control of the allergic condition affecting the nose, and I thought at first that this was another case of that type The boy's nasal condition improved promptly and quite satisfactorily under hypersensitizing treatment with an extract of house dust Later, however, during the course of treatment, he developed acute tonsillitis and suffered one of the most severe attacks of asthma that he had yet experienced Both the tonsillitis and the asthma responded quite favorably to antibiotic therapy

Cultures taken from the tonsils and pharynx showed pure growths of a staphyloccocus An intradermal test with this organism gave a strongly positive skin reaction, and also induced another severe attack of asthma The tonsils and adenoid were removed, and treatment with an autogenous staphylococcic vaccine was begun Nearly a year has passed, and the patient has had no further attacks of asthma Both the vaccine and the house dust treatment are still being administered

The question of bacterial allergy is in considerable controversy No one seems to know much about it, however, my own brief experience, limited to a few cases similar to the one just reported, has convinced me that bacterial sensitization is a constant threat, and an important factor in allergic disease

Do tonsils and adenoids "grow back"? Not infrequently, following tonsillectomy and adenoidectomy, in children especially, patches of lymphoid tissue will appear in the tonsil fossae or in the pharynx within a few months after operation These lymphoid follicles may become sources of infection, or may block the mouth of the Eustachian tube and cause impairment of hearing The presence of these growths has led to the rather widespread notion that tonsils and adenoids may recur, or "grow back," after removal Also, many of these patients have been told that the surgeon did a poor job and failed to remove all of the tonsil and adenoid tissue I am sure that practically every throat surgeon no matter how skilled, has had this experience in cases in which he was positive that he had performed a thorough operation

A very plausible explanation of this condition has been advanced by Dr Norman W Clein,[1] of Seattle In a rather extensive survey Dr Clein found that the great majority of these cases occurred in children who had allergic disease of the nose which had not been diagnosed nor treated prior to tonsillectomy and adenoidectomy The survey showed that of the untreated allergic children, who underwent this operation, 27 per cent suffered post-operative recurrence of lymphoid tissue, while the incidence of regrowth in those cases having adequate allergic management prior to operation was only 3 per cent

Dr Clein thinks these lymphoid tissue growths are due to allergy, and states that "these findings should always suggest an allergic background" "Allergic disease," he says "predisposes to hyperplasia of lymphoid tissue, especially in the nasopharynx" In my own observation, in the great majority of such cases the development of these post-operative lymphoid patches has occurred in allergic individuals

In closing, I would like to leave the thought that all candidates for tonsillectomy and adenoidectomy should be more thoroughly screened, and the presence of allergic disease either ruled out or controlled by proper management, prior to operation

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THE AMERICAN OTORHINOLOGIC SOCIETY FOR PLASTIC SURGERY, Inc

A short course on Plastic Surgery of the Head and Neck will be given by The American Otorhinologic Society for Plastic Surgery at the Morrison Hotel, Chicago, Illinois, extending from October 7 to October 9, 1955, inclusive For details write Dr Louis J Feit, 66 Park Avenue, New York, N Y

PORTUGUESE OTORHINOLARYNGOLOGICAL SOCIETY

The Sociedade Portuguesa de Otorrinolaringologia e de Bronco-Esofogologia has recently been organized and held its first meeting March 20, 1955, in Lisbon

The officers are Dr Alberto Luis de Mendonca, president, and Dr Antonio da Costa Quinta, Avenida de Liberdade 65, 1° Lisbon, Secretary

ORGANIC LESIONS OF THE LARYNX PRODUCED BY MIS USE OF THE VOICE*

GEORGE B FERGUSON, M D,

Durham, North Carolina

Laryngologists have long admitted that organic lesions of the larynx may be produced by mis-use of the voice, but few among us really know what actually constitutes mis-use of the voice, or how to correct it Diagnosis and management of patients afflicted with these lesions would benefit enormously from a sound knowledge of the methods and principles of voice production Even though none of us expect to qualify as teachers of voice, we should train our ears to perceive vocal strain and to recognize the physical and mental symptoms which attend this difficulty The laryngologist should be able to handle the problem alone in many instances, in others, he may need help from the voice or speech therapist, or from the psychiatrist. Recognition of the beginnings of vocal difficulty will enable him to know when to enlist such aid and how to direct it.

The primary use of the larynx is not as an organ of speech, but as a protective valve This protective valve, which prevents the entrance of food and fluid into the lung, has three separate levels which are capable of closure. The vocal cords, which form the lowest plane, must be brought into apposition in order to *produce* sound The ventricular bands, and the epiglottis and aryteno-epiglottic folds which form the other two planes, must be kept out of apposition or they will *suppress* sound, and spastic dysphonia or spastic aphonia will result. In addition, the muscles of the pharynx are all *constrictors*, and they, and the other muscles of deglutition, tend to close the passage-way through which laryngeal sound must come out. Undue contraction of these muscles results in muf-

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fled, throaty, or "swallowed" sounds Such muscular tensions, which can be recognized by palpation of the neck, produce fatigue and discomfort

In 1915, Muckey[1] stated a formula for "correct voice production," which called for "non-interference with *1* The actions of the vocal cords, and *2* The opening of the tube that leads out from the pharynx, the buccal cavity and the lips" Though this formula sounds simple, some of nature's strongest impulses tend to defeat it An infinite variety of spastic interference is possible, muscle tension can vary from slight to marked, and it may occur at one or at several levels, anywhere along "the tube that leads out through the pharynx, the buccal cavity, and the lips" Is it any wonder, therefore, that continued attempts to force *voice* production may bring on vocal trouble, and that traumatic, organic change may result?

The physiology and the anatomy of the larynx have been fully described by Joel Pressman[2] and Chevalier Jackson,[3] their works are well worth further study In a previous article on the recognition and management of vocal abnormalities, I[4] touched briefly on the contribution made by the voice teacher and the speech therapist toward a clearer understanding of the mechanics of voice production Both the singing teacher and the speech therapist use terms unfamiliar to most laryngologists A knowledge of these terms is in itself an introduction to the mechanics of voice production and may well lead to an easier understanding of the cause of vocal trouble

Phonation, according to the teacher of voice, may start with a "soft" or a "hard" attack Glottal stroke or "coup de glotte" describes an explosive, sudden, or "hard" attack, usually indicating anger or tension If repeated, this may result in vocal cord irritation and ultimate damage A "soft" attack is heard in the gradual onset of phonation It is associated with pleasurable sensations and relaxed well-being Phonation is concluded when the vocal cords are released "Release," too, may be soft and gradual, or it may be grunting, explosive, and productive of irritation

"Range" is the term applied to the tone area covered by an individual voice from the lowest to the highest possible note Spoken voice normally falls in the lower one-third of the tonal "range" The "chest register" is employed in producing the lowest tones, here, only the outer portions of the vocal bands vibrate. The lighter "head register" produces the highest tones, when this mechanism of voice production is employed, as in the falsetto voice only the inner edges of the vocal folds vibrate

The middle range of tones is produced by a mixture of the two preceding "registers," and utilizes the entire width of the vocal cords "Resonance" is directly due to the shape, size and character of the infraglottic and the supraglottic spaces The original thin, weak laryngeal tone is modified by these amplifying, resonating chambers, and the ultimate tone, with its own characteristic blend of primary tones, overtones, and partials, has a "quality" that may be unmistakably identified with the individual

Three simple factors are often stressed as the basis for correct vocal technique First, a good speaking or singing voice depends upon the support provided by the diaphragm, aided by the abdominal muscles and those of the back The proper use of the diaphragm, and the controlled force of the column of air thus obtained, does much to eliminate the use of laryngeal and extra laryngeal muscles to support tone and to balance pitch. Second, the straightness of the spine, and the position of the head, are important to sound production When the spine is straight, there is a straight pathway out from the larynx, and if the head is slightly flexed, the anterior cervical muscles are relaxed, preventing constriction The proper position for phonation is the same as the proper position for mirror laryngoscopy (see Fig 1) The same open pathway that permits the laryngologist to see permits free egress to sound Third, space in the oropharynx may be enlarged, and a corresponding increase in roundness of tone or resonance may be accomplished by the elevation of the soft palate The levators of the soft palate are difficult to train, but the patient may be helped to get the idea by yawning, an act which brings them into play

It is important in vocal analysis to listen to the singing as well as to the speaking voice One is occasionally amazed to find a good, clear singing voice in a patient whose speech is hoarse, raucous, or even almost totally suppressed When present, a good singing voice provides a splendid base on which to begin vocal re-education When both the speaking and the singing voice are muffled and hoarsened by spastic contraction, it may be difficult, indeed, to effect a cure The patient may need long study with a competent vocal instructor before improvement can be effected

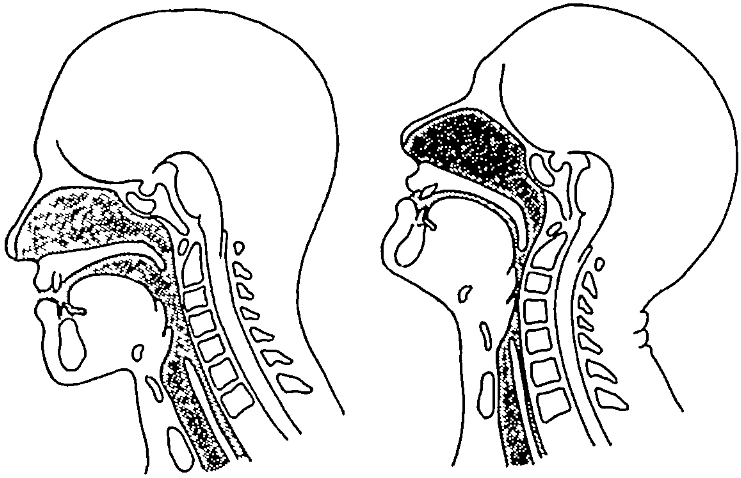

Fig 1 Showing proper position for phonation with open airway and improper position producing constriction

The psychiatrist's point of view may also be of help to the laryngologist All phases of voice production depend upon psychic or emotional balance The voice is not only characteristic of the individual, but it also varies with his every mood From it one quickly recognizes the emotional states of happiness, anger, fear, or sorrow Paul Moses[5] asserts, that in the field of psychiatry many clinical diagnoses can be made simply by listening to the rhythm and quality of the voice

As laryngologists, we see two major classes of functional voice disorder the hypofunctional or pseudoparetic type, i e hysterical aphonia, which *never* leads to organic laryngeal disease, and the spastic or hyperfunctional type, which often does

Certain types of occupation, as well as certain types of personality, tend to the production of spastic vocal disorders and to ultimate vocal cord damage Such organic damage is most likely to occur in the person whose occupation and whose personality tend toward the creation of tension. When a high geared, nervous individual with rapid, explosive, continuous speech is placed in a job which fosters tension trouble seems inevitable Patients with some type of spastic vocal disorder are surprisingly frequent in everyday nose and throat practice

They vary from the factory worker who pitches his voice to speak above noise, to the politician who distorts his voice to speak below his normal range in order to sound impressive The teacher, the minister, the high pressure salesman, the harried mother of several noisy and overly articulate children, all are candidates for the several varieties of this particular disease Even the overly articulate children themselves are not exempt.

One needs a practiced ear to recognize the early stage of spastic dysphonia, before organic damage is evident and to sense the true cause of the strained, tired neck and chest muscles, or of the vague discomforts these patients relate to the throat and neck Even in later stages when diffuse traumatic laryngitis is present, it is often difficult to separate or to distinguish cause from effect. Many such illnesses have been treated vigorously by antibiotic drugs and by voice rest, and most, if not all, have promptly recurred when the rest period ended All cases of chronic or frequently recurring laryngitis should be suspected of vocal trauma

Acute vocal traumatic lesions come on suddenly and usually subside promptly Submucous hemorrhage of the vocal cords is not uncommon in the enthusiastic sports fan, and acute traumatic laryngitis may be induced by similar indiscretions Lesions of this type usually clear with brief periods of vocal rest and rarely leave any permanent damage I have had two singers, however, who have suffered repeated submucous hemorrhage induced by the vocal strain of reaching for a high note Each of these patients had actual varicosity of vocal cord vessels Light diathermic coagulation, employing a Walker retinal detachment pin on the end of an insulated rod, served well to prevent further hemorrhage in these patients

Some of the more chronic organic laryngeal disorders, such as vocal nodule, contact ulcer, and certain types of diffuse laryngitis, appear to be definitely associated with spastic or hyperfunctional disorders, a seeming fact which is difficult to prove No one as yet has given an adequate explanation for the invariable location of vocal nodule at the junction of the anterior and middle one-third of the vocal cords The following explanation occurred to me when, at a recent Academy meeting, I saw Dr Pressman's movie of the sphincter closing mechanism It showed the vocal cords first coming into contact with each other at the junction of their anterior and middle one-third, then closure of the remaining length of the vocal cords was completed This was followed by approximation of the ventricular bands, which also began at the junction of the anterior and the middle one-third Final and absolute closure was completed by approximation of the epiglottis and the arytenoepiglottic folds (see Figs 2 and 3) It seems possible that partial, spastic closure of the false cords might produce a rubbing or damping action which, repeated many times, could account for local irritation, and ultimate localized thickening of the vocal cords

Vocal nodule occurs most frequently in workers who must speak above noise It is a common disorder among the women factory workers in our town, the noise level is high in our tobacco and textile plants, and many jobs require vocalization above it Its prevention, and sometimes its cure, seems to lie in simple reduction of voice use This may be brought about, on the part of industry, by insulation and sound-proofing, or by the use of amplifying equipment, until these measures have been accomplished, the patient must learn to speak as little as possible and to move closer to the person to whom he is speaking Deafness due to industrial noise is now a com

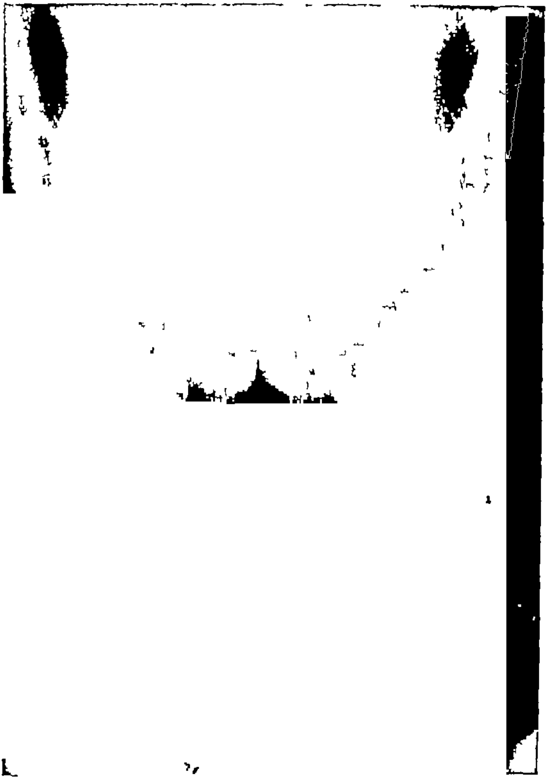

Fig 3 PA planigram of the normal larynx during phonation showing vocal cords approximated and ventricular bands relaxed

pensable disability Management's increasing awareness of responsibility will undoubtedly result in more active efforts toward noise control

Vocal nodules vary in appearance at the time of first examination. The more recent ones have a soft, edematous appear-of vocal rest and rarely leave any permanent damage I have had two singers, however, who have suffered repeated submucous hemorrhage induced by the vocal strain of reaching for a high note Each of these patients had actual varicosity of vocal cord vessels Light diathermic coagulation, employing a Walker retinal detachment pin on the end of an insulated rod, served well to prevent further hemorrhage in these patients

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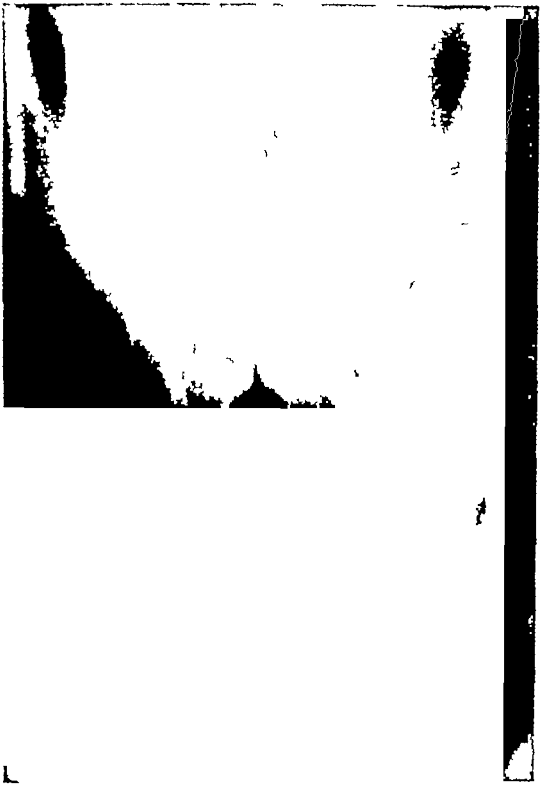

Fig 2. PA planigram of the normal larynx during phonation showing vocal cords approximated and ventricular bands relaxed

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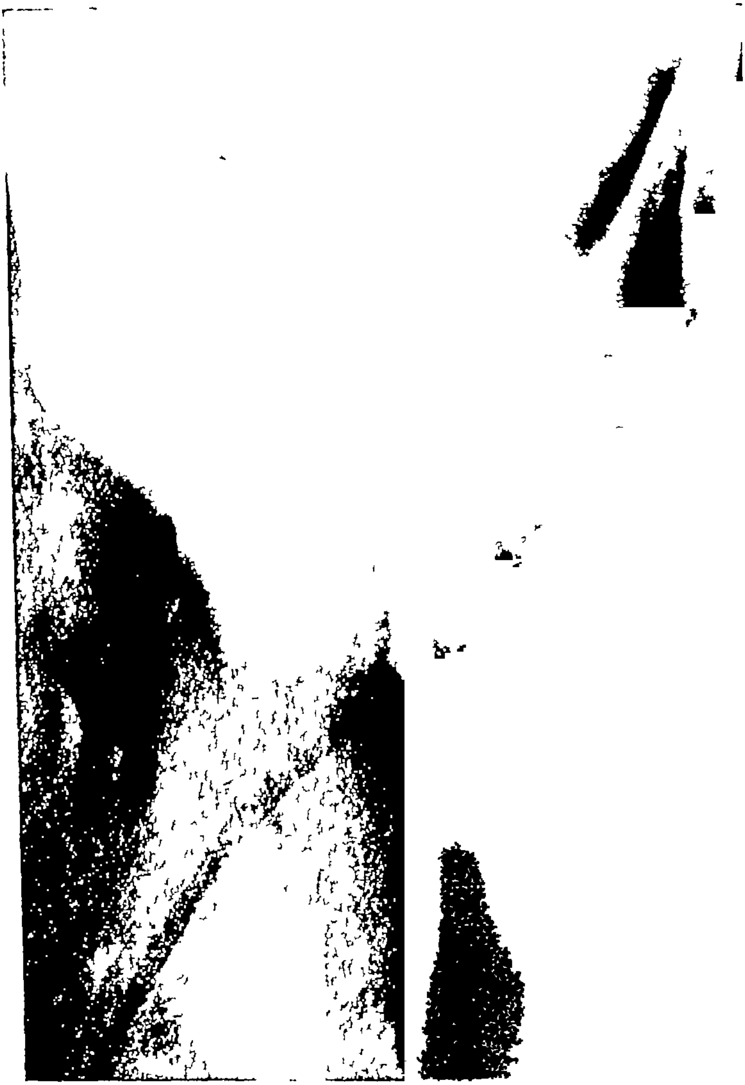

Fig 3 PA planigram showing spastic dysphonia vocal cords and ventricular bands both approximated

ance, while older lesions have the firm, hard appearance of a callus These older nodules must usually be removed before improvement can be brought about The soft, edematous type often fade away with simple voice rest It is obvious that

surgical removal of these nodules is not enough, and that correction of the vocal problems that induce them is essential to prevent recurrence

Contact ulcer is much less frequent than vocal nodule, and always presents a complicated problem The patient with this type of lesion usually exhibits the maximum of nervous tension, often coupled with a past history of "nervous breakdown" or of other psychiatric problems He belongs to a group of "over-doers," mentally, physically, and vocally The primary lesion here is perichondritis of the vocal process of one or of both arytenoids, and on this there is often superimposed a pyogenic granuloma which may, in some instances, assume a confusingly large size I remember with chagrin one such patient who presented a cherry-sized posterior lesion which caused hoarseness and mild dyspnea Our mistake in diagnosis, later corrected, was furthered by the pathologist, who mistook the new-forming capillaries of granuloma for capillary hemangioma

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The hard drinking, hard smoking, fast talking salesman is a particular candidate for the type of traumatic, hypertrophic laryngitis which seems most likely to continue to ultimate malignant change Many of these people, when first seen show metaplasia of the vocal cords clinically indistinguishable from carcinoma *in situ* When a period of two weeks of complete abstinence from all three forms of vocal irritation produces no improvement, or when actual progression is noted biopsy is indicated I usually employ one of the therapeutic vitamin and mineral preparations and look for general physical abnormalities, especially nephritis and diabetes It is extremely important that these patients understand the cause of their trouble, since recurrence is frequent unless the new program becomes a permanent part of their way of living

Fig 3 PA planigram showing spastic dysphonia vocal cords and ventricular bands both approximated

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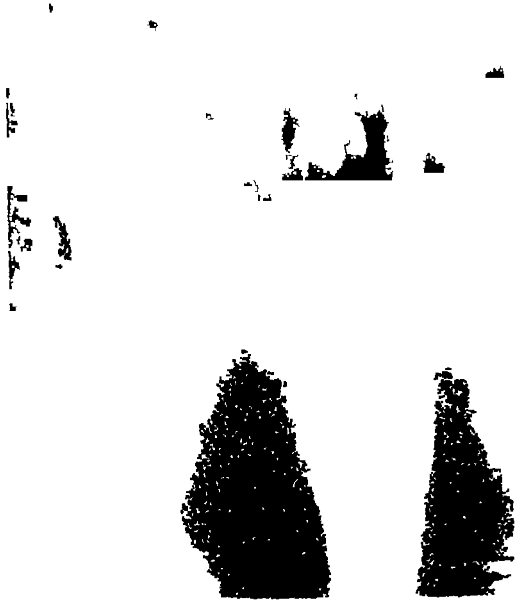

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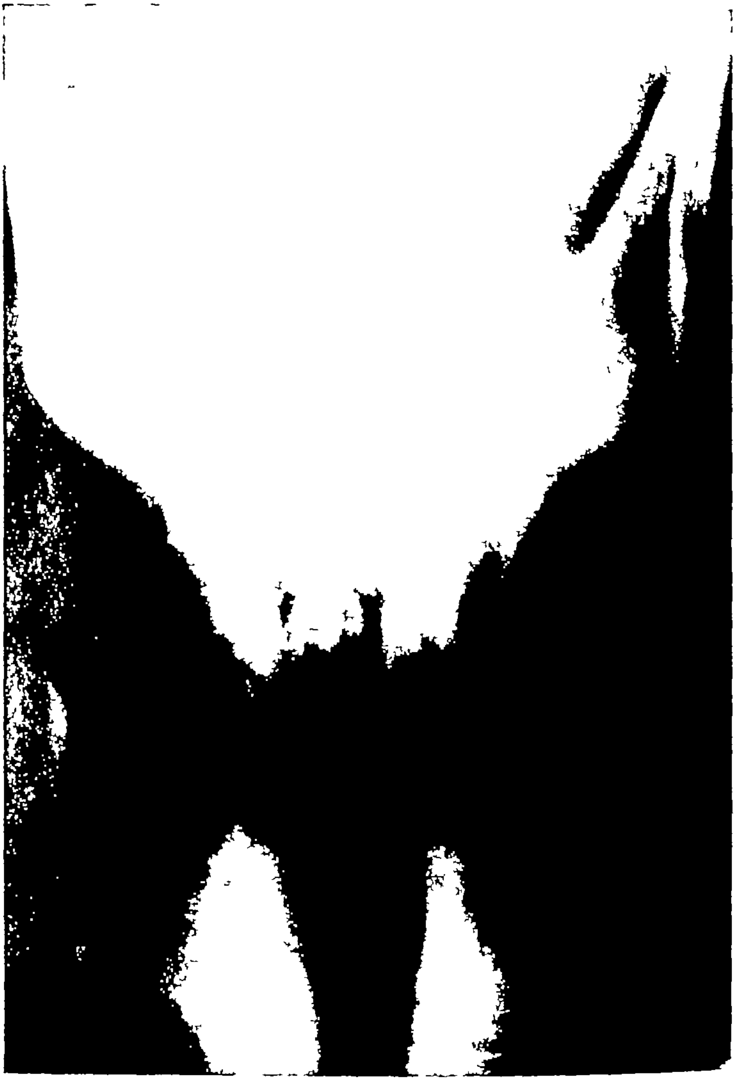

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CONCLUSIONS

1 Organic lesions of the larynx may be produced by spastic mis-use of the voice Certain types of occupation, as well as certain types of personality, tend to the production of vocal tension and hence to organic laryngeal damage

2 Few laryngologists are trained to recognize vocal mis-use A knowledge of the methods and principles of voice production, together with an understanding of the emotional problems of the patient who tends to mis-use his voice, is necessary to the proper treatment and consequent permanent cure of many of these laryngeal lesions

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TRAUMATIC TRACHEAL ATRESIA *

RICHARD W HANCKEL, M D ,
Charleston, South Car

Injuries in general are occurring with increasing frequency because of the greater emphasis on speed in our land, air, and sea traffic. The following report of an uncommon injury to the trachea may serve to bring to our attention some pertinent points, which can be used in the treatment of the injuries commonly produced

The patient a young white girl 13 years old, was attending a wiener roast on March 14 1952. One of her companions tossed an unopened bottle of carbonated drink in the fire with a resulting explosion Flying slivers of glass produced multiple lacerations of the neck in the region of the thyroid cartilage The patient was taken to the near-by Naval Hospital for emergency treatment. This consisted of homostasis treatment of shock, and the insertion of a tracheotomy tube in the wound in the thyroid cartilage.

About 12 hours later when the patient was in better condition the wound was explored at the Naval Hospital The findings were as follows A laceration extending through the right ala of the thyroid cartilage just below the level of the right vocal cord and extending across to the left arytenoid, an extension of this laceration inferiorly resulting in a 3-4 mm laceration of the esophagus

At this time a low tracheotomy was performed and the wound in the larynx and upper trachea was closed in layers The wound in the esophagus was not repaired but a drain was inserted The patient remained at the Naval Hospital until March 25 1952 when she was transferred to the E. N T service at Roper Hospital by ambulance At that time she had a small amount of drainage from the laceration in the thyroid cartilage and air escaped through this on exertion. Saliva was draining from the portion of the wound which extended into the esophagus The tracheotomy tube was functioning normally Several days before the transfer a mirror examination of the larynx was reported by the Naval Hospital as revealing the vocal cords moving normally The patient had only intravenous feedings for five days before the transfer to Roper Hospital

On admission to Roper Hospital an intranasal feeding tube was inserted and tube feedings were begun Dr Edward F Parker saw her in consultation in regard to her esophageal laceration and suggested lipiodol esophagrams These were done on March 28 1952 and repeated on April 1st and April 7th. They revealed a fistulous tract between the esophagus and the trachea opposite the fifth cervical vertebra. This became progressively smaller

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* Read at the meeting of the Southern Section, American Laryngological Rhinological and Otological Society Inc. Charlottesville Va., January 22, 1956

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The patient was discharged from Roper with feeding tube and tracheotomy tube in place on April 8, 1952 She had received penicillin intramuscularly 400,000 units daily, and had an essentially afebrile course The esophagram was repeated on April 29, 1952, and revealed that the fistula had closed completely The feeding tube was removed May 1, 1952

Mirror examination of the larynx while in the hospital revealed a gradually progressing bilateral abductor paralysis of the vocal cords By April 29, 1952 she had complete fixation of the cords in the midline and was almost aphonic. It was thought that this progressive paralysis was due to progressive involvement of the recurrent laryngeal nerves with scar tissue from the wound, as the cords were motile when first examined at the Naval Hospital

She was readmitted to Roper Hospital on May 23, 1952, and a mobilization of the left arytenoid cartilage was done following the Clerf technique and using a horizontal incision At operation it was found that considerable cartilage and bone had been laid down along the line of the original laceration so that the left arytenoid area was transformed into a solid osteo-cartilaginous strip Complete mobilization of the left arytenoid was not obtained The operation was done on May 22, 1952

The patient developed an abscess near the medial end of the incision after operation This was incised and drained on May 31, 1952 A fistula between the larynx and neck developed, which closed spontaneously in a few days after insertion of a feeding tube The patient subsequently made an uneventful recovery She was discharged home June 7, 1952 Her tracheotomy tube was still in place, but was blocked off part of the time

At my suggestion the patient saw Dr Louis Clerf at Jefferson Hospital September 15, 1952 His opinion and suggestions were as follows

"Your patient apparently has an atresia of the larynx which I believe is cicatricial rather than paralytic

"I did a direct examination, but could see no evidence of a lumen

"I believe that it will be necessary to do a laryngotomy dividing the thyroid cartilage in the midline, removing all cicatricial tissue and securing an obturator It is important in all of these manipulations to avoid all undue trauma and pressure necrosis I would suggest that a sponge rubber obturator be employed encased in a finger cot and surrounded by skin graft The sponge rubber should be secured preferably with stainless steel wire

"The question of time of its retention in the larynx is difficult to state I have preferred leaving these in from four to six weeks, when I used a pure gum rubber tube With sponge rubber the time has been lessened slightly

"In any event it is going to take a long time to get this young lady well, but it appears to me that the prognosis should be good"

On October 20 1952 she was re-admitted to Roper Hospital and a thyrotomy was done. On opening the larynx a circular band of scar tissue was found just below the level of the vocal cords, almost completely occluding the tracheal lumen A direct laryngoscopy done just before the operation had revealed both cords fixed in the midline and no evidence of a lumen. She had been dependent on the tracheotomy tube for breathing for several months before operation and she had been unable to speak except for a very weak whispered voice.

The band of cicatricial tissue was excised and the edges of the normal mucosa were undermined and approximated using interrupted sutures of No 0000 chromic catgut.

At the suggestion of Dr Martin Zwerling of the Naval Hospital who was my assistant the right arytenoid cartilage was resected through an incision through the mucosa on the medial aspect of the cartilage. This wound was closed with No 0000 chromic catgut in continuous interlocking sutures. An obturator of sponge rubber enclosed in a finger cot was laid in place It extended from just above the vocal cords to about an inch below them. The upper end was fixed in place with a cotton suture passed through the soft tissues of the neck the lower end with a cotton suture passed through the tracheotomy wound The two ends were tied loosely together on the neck. The wound was closed in layers and a dry dressing was applied.

The patient made an uneventful recovery and was discharged home November 4 1952 with the obturator in place. She was re-admitted November 21, 1952. By using a direct laryngoscope and alligator forceps the obturator was visualized and grasped the suture was divided and the obturator removed. This was done under intravenous sodium pentothal anesthesia. She made an uneventful recovery and was discharged the next day

For about the next 12 months she progressed favorably Her tracheotomy tube was removed after being blocked off for about three weeks. This wound gradually filled in but never closed completely Her voice improved considerably most of her phonating being done by the approximation of the false cords. Occasional bouts of acute respiratory infections necessitated hospitalization for inhalations of sodium lauryl sulphate and for penicillin therapy in December 1952

Again on November 2 1953 she was re-admitted to Roper Hospital because of nocturnal dyspnea and stridor This became so marked that it was necessary to re-insert the tracheotomy tube This was done on the ward under local anesthesia on November 3 1953 Two days later a bronchoscopy was done which revealed that the band of scar tissue had reformed just below the level of the cords A 4x26 Jesberg bronchoscope was the largest one that could be introduced into the narrowed lumen. The patient was discharged on November 7 1953 with the tracheotomy tube in place. Our plan of therapy was to attempt subsequent dilatations of the larynx, using solid metal laryngeal bougies such as are used to dilate congenital webs of the larynx.

These dilatations were done under intravenous sodium pentothal anesthesia on November 28 1953 December 12 1953 January 16 1954 January 23 1954 and February 6 1954 These dilatations apparently accomplished very little as it was impossible to de-cannulate her and so treatment was discontinued

She was not seen again until May 7, 1954 when she came in for a routine check in the office She had gained about 10 pounds in weight and her voice was somewhat stronger On mirror examination of the larynx some motility of the right cord was noted She was still wearing a tracheotomy tube which was blocked most of the time

At the meeting of the American Academy of Ophthalmology and Otolaryngology in New York in September, 1954, Dr Joel Pressman's advice was sought He stated that in his experience, cicatricial rings frequently re-formed after the original excision, however, if a secondary fissure is done and a vinyl plastic tube sutured in the trachea over the site of the scar tissue band the chances of the band forming a third time are rather remote

Following his suggestion, a secondary laryngofissure was done under general anesthesia at Roper Hospital on September 30, 1954 As was anticipated, a band of scar tissue was present just below the level of the cords Several longitudinal incisions were made in this band and a portion of a vinyl plastic anesthesia tube was sutured in place with tantalum sutures The upper suture was brought out through the soft tissues of the neck, the lower one through the tracheotomy wound Each was tied over a gauze sponge The wound was closed in layers The patient made an uneventful recovery, and was discharged four days later on October 4, 1954

This intratracheal tube was left in place almost seven weeks It was removed under general anesthesia by means of a direct laryngoscope and alligator forceps on November 10, 1954 The patient was discharged that same afternoon

The tracheotomy tube was left in place, but completely blocked until December 22, 1954 It was removed on this date, and to date there has been no recurrence of the stridor or dyspnea Her voice has become much stronger since her final operation Mirror examination of the larynx shows an adequate glottic chink posteriorly of about 4 to 5 mm, and some motility of the right cord Phonation is apparently accomplished by the partial approximation of the true cords

COMMENT AND SUMMARY

A great amount of new work has been done on surgery of the larynx and trachea, and more is in progress This case is presented as a contrast in various methods of surgical approaches to the problem of relieving laryngeal and tracheal atresia secondary to trauma Clerf's modification of Woodman's operation was first tried but proved inadequate, because a cicatricial band was blocking the airway below the level of the true cords The cords themselves were anchored in the midline because of cicatricial tissue pinching off the recurrent laryngeal nerves

The next procedure of laryngo-fissure, excision of the cicatrix, resection of the arytenoid, and the insertion of a foam rubber obturator covered by a finger cot was not the complete answer, because of the secondary formation of the cicatricial band Dilatation of the band with metal laryngeal bougies failed to give satisfactory results Finally, a secondary laryngo-fissure the making of longitudinal incisions in the scar tissue, and the insertion of a vinyl plastic intratracheal anesthesia tube has so far proven satisfactory , however, it is very possible that the larynx may have to be opened again, the scar tissue excised, and a graft applied before a completely satisfactory result is obtained

96A Bull Street.

BRONCHOESOPHAGOLOGY COURSE

The next Bronchoesophagology Course to be given by the University of Illinois College of Medicine is scheduled for the period October 24 to November 5, 1955, under the direction of Dr Paul H. Holinger

Interested registrants will please write directly to the Department of Otolaryngology, University of Illinois College of Medicine, 1853 West Polk Street, Chicago 12, Illinois.

THE BLUE EARDRUM REPORT OF A CASE IN WHICH TREATMENT WAS RADICAL MASTOIDECTOMY[*]

KINSEY M SIMONTON, M D,

Rochester, Minn.

Johnson,[1] in 1953, reviewed the literature on the subject of the blue eardrum, otherwise known as idiopathic hemotympanum He reported one case in detail In his patient, blood stained fluid continued to collect in the tympanic cavity after cortical dissection of the mastoid air cells had been done In conclusion Johnson wrote.

"By a process of elimination, we have arrived at the conclusion that somewhere in the middle ear cleft of these patients exists an area of varicosity, or even hemangioma, which fails to undergo complete tissue repair, but repeatedly breaks down to permit the escape of fresh blood Some day one of us will exercise the temerity of performing a complete radical mastoid operation upon one of these cases, and perhaps find the true explanation "

In the present paper a case in which idiopathic hemotympanum was treated by radical mastoidectomy is reported The report is presented in considerable detail, in view of the fact that Johnson found "less than a dozen" references to hemotympanum in the literature.

REPORT OF A CASE

A white woman 49 years old was first examined in 1944 She complained primarily of pain in the region of the cervical part of the spinal column, and she dated the onset of this pain to a fall 18 months before Many variable and unrelated complaints suggested nervous instability Intermittent spasm of the muscles of the right side of the face accompanied exacerbations of her pain Examination of the ears revealed scarring of the right tympanic membrane There was no discharge Perforation was sought, but not found Tests with tuning forks indicated a combined type of hearing loss on the right The history indicated that otorrhea had not occurred since the age of eight years

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[*] From the Section of Otolaryngology and Rhinology Mayo Clinic and Mayo Foundation The Mayo Foundation, Rochester Minnesota is a part of the Graduate School of the University of Minnesota

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Examination of the ears in 1946 had produced similar findings.

The patient was examined again in July, 1952. At this time she complained of pain in the right ear The pain had begun in January, 1952, and had increased progressively in severity The patient said that anti allergic therapy had given no relief Temporary relief of pain had followed aspiration of fluid from the ear The referring physician said that the fluid was dark brown, and that Papanicolaou stain had revealed no malignant cells. The patient reported that spasm of the muscles of the right side of her face had stopped after the spontaneous discharge of brown fluid from the right ear in April 1952. Traction applied to the head had resulted in temporary relief of her pain.

Examination of the right ear disclosed marked scarring of the tympanic membrane. The tympanic membrane was dark blue, but did not bulge. Dark brown sanguineous fluid was removed from the tympanic cavity after myringotomy Roentgenologic examination of the right mastoid was interpreted as showing partial sclerosis with decalcification of the remaining mastoid cell walls. Audiometric examination after myringotomy revealed loss of perception in the right ear which averaged 45 decibels through the speech frequencies of 500 to 2 000 cycles per second Neurologic and general physical examinations disclosed no pertinent changes. Examination of the blood with special reference to coagulation factors revealed no abnormalities.

The right mastoid was explored surgically on July 19, 1952. A post auricular incision was made The mastoid cortex was seen to be moderately thickened Some of the mastoid cells contained brown fluid The mucosa lining the cells was not thickened but was stained brown The bone forming the intercellular septa was soft and spongy Free bleeding was encountered The mastoid cell system was extensive All visible cells were exenterated The dura overlying the middle fossa of the skull and the sigmoid sinus were purposely exposed but this disclosed no abnormality The superior wall of the bony external auditory canal including the superior portion of the tympanic ring was removed The ossicles were left *in situ* The limited inspection permitted by this type of exposure revealed no abnormality of the mucosa lining the tympanic cavity A Lempert type of flap was fashioned and the ear was closed as in a modified radical mastoidectomy

Microscopic examination of tissue removed from the mastoid process was reported to show slight increase in connective tissue around the air cells."

The patient was observed periodically On September 12, 1952, the mastoid cavity was completely lined with epithelium At this observation the bluish discoloration of the tympanic membrane was noted for the first time since the operation. Needle aspiration failed to remove fluid from the tympanic space Repeated observations produced similar findings. The patient complained of intermittent, throbbing pain in her right ear When she was seen on February 2 1953 the tympanic membrane was found to be bulging and dark brownish red Fluid was obtained by myringotomy and inflation. Relief of pain followed and persisted for three days.

Roentgen therapy was given in April 1953 A total dose of 800 roentgens was applied in two treatments of 10 mintues each to a field of 10 cm in diameter centered over the right ear No benefit was noted

A second operation was performed on July 24, 1953 The mastoid cavity was exposed by an antauricular incision. The skin of the external auditory canal was incised external to the tympanic ring The tympanic membrane, incus and malleus were removed Considerable scar tissue was found around the stapes The bony wall covering the horizontal portion of the fallopian canal was absent The facial nerve in this area was enlarged to approximately four times its usual diameter The mucous membrane lining the tympanic cavity and tympanic extremity of the eustachian tube was removed with exception of that lying in the niches of the round and oval windows The mucous membrane appeared to be fibrous but otherwise was normal The tensor tympani muscle was removed from its semicanal Bleeding during the operation was not excessive A split-thickness skin graft was applied

The skin graft failed to take Epithelization of the tympanic space took place slowly, being complete in ten months To the time of this writing no discharge has been noted in the right ear since April, 1954 The patient reports that her pain remains

SUMMARY AND CONCLUSION

One case of blue eardrum, or idiopathic hemotympanum, is reported Complete inspection of the mastoid and tympanic cavities was made after radical mastoidectomy The source of the blood-stained secretions in the ear was not identified. Johnson's hypothesis is not supported by the findings made in examination and treatment of this patient.

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AMERICAN ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY HOME STUDY COURSES

The 1955-1956 Home Study Courses in the basic sciences related to ophthalmology and otolaryngology, offered as a part of the educational program of the American Academy of Ophthalmology and Otolaryngology, will begin on September 1, and continue for a period of ten months Detailed information and application forms can be secured from Dr William L Benedict, the executive secretary-treasurer of the Academy, 100 First Avenue Building, Rochester, Minnesota Registrations should be completed before August 15

UNIVERSITY OF ILLINOIS ANNUAL ASSEMBLY IN OTOLARYNGOLOGY

The Department of Otolaryngology, University of Illinois College of Medicine, announces its Annual Assembly of Otolaryngology from September 19 through October 1, 1955 This Assembly will consist of two parts

Part I — September 19 through September 24, 1955, will be devoted to surgical anatomy of the head and neck, fundamental principles of neck surgery and histopathology of the ear, nose and throat. This week will be under the personal direction of Maurice F Snitman, M D

Part II — September 26 through October 1, 1955, will be devoted entirely to lectures and panel discussion of advancements in otolaryngology The chairman of this section will be Emaneul M Skolnik, M D

Registration is optional for one or both weeks For further information, address Dr Francis L Lederer, 1853 West Polk St., Chicago 13, Ill

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POST-GRADUATE COURSES AT TEMPLE UNIVERSITY

The following Post-Graduate Courses to be given in this Department during the current year

Post Graduate Course in Broncho-Esophagology, June 13 24, 1955, October 17 - 28, 1955

Post-Graduate Course in Laryngology and Laryngeal Surgery, September 19 - 30, 1955

These courses are all to be given in the Department of Laryngology and Broncho-esophagology, Temple University Hospital and School of Medicine, under the direction of Dr Chevalier L. Jackson and Dr Charles M Norris The tuition fee for each course is $250 00 Further information and application blanks can be obtained from Dr Chevalier L Jackson, 3401 N Broad Street, Philadelphia 40, Pennsylvania

ACADEMY-INTERNATIONAL OF MEDICINE

A completely revised Fourth Edition of "Professional Films" is now in compilation (The frequency and number of future insert pages necessary to assure a comprehensive index that is continuously current over a period of years will be determined by the volume of forthcoming productions) It will include new sections providing biographical data on authors, and information on the audio-visual activities of medical schools, dental schools and post-graduate teaching centers

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You are urged to assist by *1* Informing film authors of this announcement so that they can write for questionnaires *2* Providing the film title and full name and address of any film author Write to the Academy-International of Medicine, 601 Louisiana Street, Lawrence, Kansas

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NEW YORK EYE AND EAR INFIRMARY ALUMNI ASSOCIATION DINNER

A subscription dinner honoring Edgar B Burchell, D Sc on the completion of 60 years of distinguished service at the New York Eye and Ear Infirmary, will be given on June 10, 1955, at the 7th Regiment Mess, 643 Park Avenue, at 67th Street, New York City Cocktails and reception at 6 30, dinner at 7 30 P M For further information write to Dr Joseph H Krug, Secretary-Treasurer, Alumni Association, New York Eye and Ear Infirmary, 218 Second Avenue, New York City

SOUTH CAROLINA SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

Plans have been completed for a joint meeting of the North Carolina Eye, Ear, Nose and Throat Society and the South Carolina Society of Ophthalmology and Otolaryngology at Columbia, S C, on September 12, 13, and 14, 1955 Headquarters will be the Columbia Hotel

The following ophthalmologists will be on the program Dr E W D Norton of New York, Dr Frank Carroll of New York, and Dr William B Clark of New Orleans

An announcement of three guest otolaryngologists will be made later

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THE
LARYNGOSCOPE.

VOL LXV JUNE, 1955 No 6

LATERAL VESTIGIAL CYSTS AND FISTULAS OF THE NECK.*

BRUCE PROCTOR, M D ,
Detroit, Mich.

In presenting a subject on the anomalies of the lateral neck one is obliged to review briefly the intricate embryology of the region

DEVELOPMENT OF THE PHARYNX AND NECK.

A large part of the human neck is formed from the embryonic visceral arches During the fifth embryonic week the visceral (branchial) arches are seen in the region of the neck and pharynx. Four arches are seen superficially, the fifth and sixth arches are submerged By the beginning of the seventh week all external traces of the visceral arches have disappeared

The entodermal lining of the primitive pharynx covers the inner surface of the arches and passes outward in the recesses between them (pharyngeal pouches) to come into contact for a short time with the epithelial covering of the body (ectoderm) which dips in to meet it (visceral grooves or clefts) The membrane formed by the union of the ectoderm and endoderm in the recesses between the arches is called the cleft membrane (closing membrane) It is never ruptured but is soon invaded by the mesoderm of the neighboring arches (see Fig 1)

Presented as Candidate's Thesis at the Fifty Ninth Annual Meeting of the American Laryngological, Rhinological and Otological Society Inc Hollywood Fla., March 16, 1955

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In each arch there develops a cartilaginous skeleton, an aortic or vascular arch connecting the ventral and dorsal aortas, a large nerve along its anterior border, a smaller one along its posterior, and a muscle component

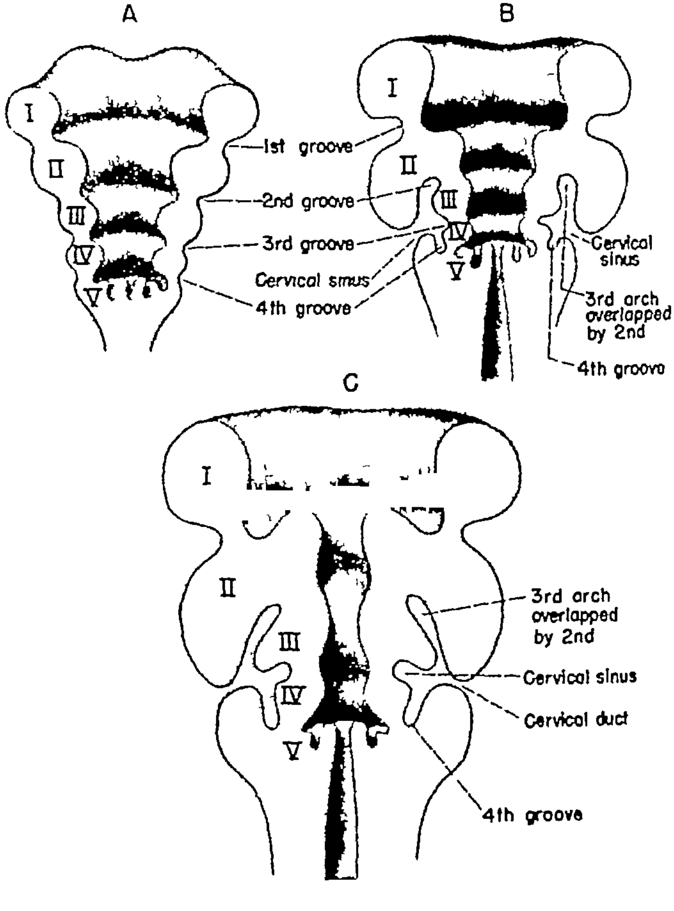

Fig 1 Showing Early Development of the Pharyngeal Wall

A. Showing proximity of ectodermal floor of branchial clefts to the entodermal pharyngeal pouches

B Rapid growth of the hyoid arch II overshadows postoral arches forming the cervical sinus

C Occlusion of the cervical sinus (note its position lateral to groove and pouch III and its communication with grooves II and IV)

Redrawn from Ward and Hendricks 'Tumors of the Head and Neck."[11]

NERVES OF THE VISCERAL ARCHES.

Each nerve of a visceral arch supplies the muscles of that arch and the pharyngeal pouch and groove lining in front of the arch (see Fig 3) The Vth nerve and the Gasserian ganglion lie at the base of the mandibular arch The ganglia of the VIIth and VIIIth nerves are situated at the base of the hyoid arch in front of the otic vesicle The glossopharyngeal and its ganglia lie behind the otic vesicle at the dorsal wall of the pericardium The large ganglionic mass of

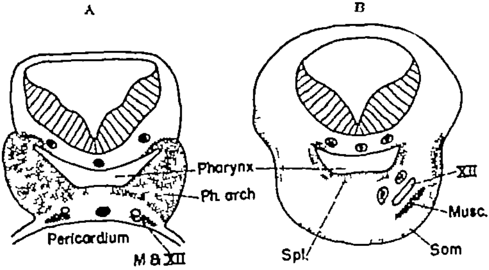

Fig. 4. Showing in the first diagram the solid condensations of the pharyngeal arches laterally with loose subpharyngeal mesoderm below in which lie the vessels and structures (m XII) of the epipericardial ridge. In the second diagram the condensed mesoderm has been "deposited on the pharyngeal wall (Spl) on the one hand and against the ectoderm (Som) on the other so that the XIIth nerve and its muscles lie in loose mesoderm between these two superficial to the pharyngeal structures and deep to the somatic.

Redrawn from Fraser Manual of Embryology *

the vagus lies over the bases of the fourth, fifth and sixth arches and near the dorsal wall of the pericardium The spinal accessory nerve is a backward extension of the vagus to the cervical region of the spinal cord Its spinal fibers supply the sternomastoid and trapezius muscles, both of which are of branchial origin The hypoglossal nerve is not related to the branchial apparatus The tongue musculature is derived from the last three occipital segments and is somatic in nature (see Fig 4)

MESODERMAL STRUCTURES

The lateral pharyngeal walls are made up of concentrated mesoderm in the form of arches. Arches III to VI do not pass to the midline, leaving the central region without an arch concentration (see Figs 2, 5). The floor of the central region has a limited subentodermal condensation of mesoderm, followed by a loose mesoderm and finally the pericardium. In the lateral wall the entire space between ectoderm and entoderm is filled with dense mesoderm. The arteries extending from the pericardium pass through the loose subpharyngeal layer. During the fifth week the dense mesoderm in the arch divides into a visceral and a superficial condensation with a loose intervening mesoderm (see Fig 2-B). This change in the arch is associated with disappearance of the arch form on the surface and in the interior of the pharynx. rotate as the pharynx grows forward leaving only their The aortic arches now come to lie on the pharyngeal wall and branches of distribution in the condensations of the wall. The nerves of the arches remain deep to the arteries and in the pharyngeal wall.

The hypoglossal nerve with its muscle cells extends forward between the superficial and deep mesodermal layers. It passes forward superficial to the carotids, thyroid, thymus, larynx, superior laryngeal and glossopharyngeal nerves, and the hyoid. If any connection were to persist between the two walls the nerve would come up against it. None exists, however, until it reaches a branch given off by the external carotid (a visceral artery) to the muscles of the outer wall (sternomastoid branch of the occipital).

The pharyngeal wall and the dorsal structures grow rapidly causing a forward elongation. The relatively slower ventral growth keeps the pharynx curved at first around the top of the pericardium, but as this ventral growth becomes more manifest the separation from the pericardium occurs, and the neck becomes evident[2]

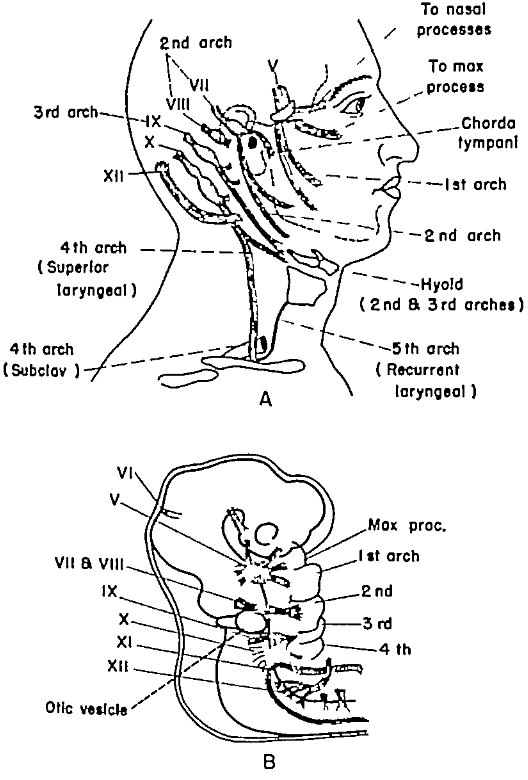

Fig 1 A—Showing what becomes of the Nerves of the Visceral Arches.

B. The Visceral Arches and Their Nerves and Ganglia in a Human Embryo of the fifth week.

Redrawn from Keith "Human Embryology and Morphology"

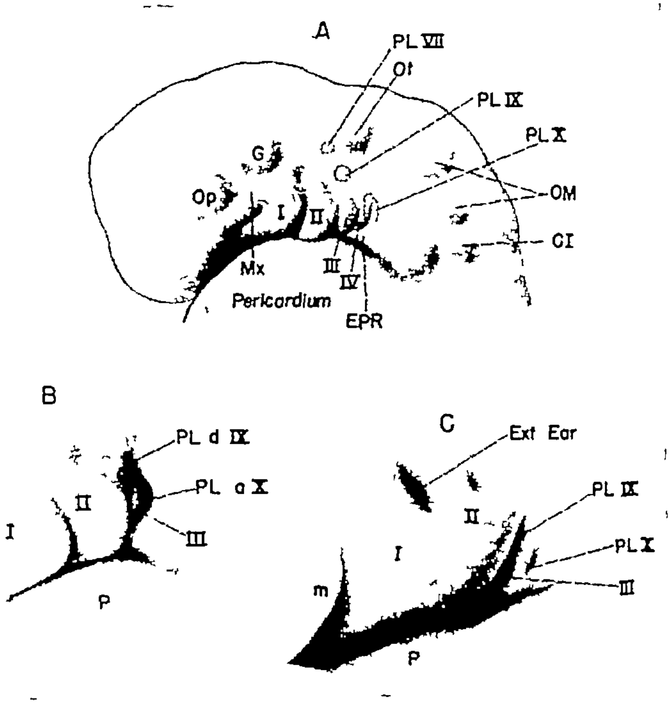

Fig 4 A—The beginning of the cervical sinus Neck of a human embryo at the end of the fifth week of development showing the triangular field in which the third and fourth arches are subsiding I mandibular arch II hyoid arch PL VII placode of facial nerve PL IX placode of glossopharyngeal nerve I L X placode of vagus CI first cervical somite OM occipital myotomes Ot otocyst G, Gasserian ganglion Op slight prominence of eye Mx maxillary process EpR epicardial ridge continual with the caudal boundary of the arch-field Arches III and IV are being overshadowed by the rapidly growing hyoid arch

B View of arches and grooves in a 10 mm embryo (about five weeks) showing the beginning of the cervical sinus disappearance The encroachment of the marginal folds narrows the opening into the depressed area the smaller fourth arch is being covered P pericardium I II III pharyngeal arches The widely open placodal recess of vagus PL a X is below and behind the narrow duct PL d IX leading to the glossopharyngeal ganglion The epipericardial ridge is very prominent below and behind the third arch forming a posterior boundary to the arch area

C Arch area in a 12 mm embryo (about six weeks) Further closure has left only an area of the flattened third arch exposed The placodal areas are buried so is the fourth arch Shows the second arch fused below with the first but forming the flexure line of the neck by its posterior border behind this third arch a small area PL X indicates the point of attachment of the remnant of the tract leading to the placodal vesicle of the vagus and PL IX points to what is apparently a similar but less marked track to the placodal vesicle of the glossopharyngeal P pericardium m mouth

Redrawn from Frazer*

ECTODERMAL ASPECT AND THE CERVICAL SINUS

The first (mandibular) arch especially, and also the second (hyoid) grow much more rapidly than the remaining arches The second arch grows over, reaches the thoracic body wall and buries the third and fourth arches so that an ectodermal space (cervical sinus) becomes enclosed (see Fig 1) The enclosed cervical sinus is in contact with the second, third and fourth pharyngeal pouches. The cervical sinus is formed in the sixth and seventh weeks of embryonic life but disappears before the end of the second month

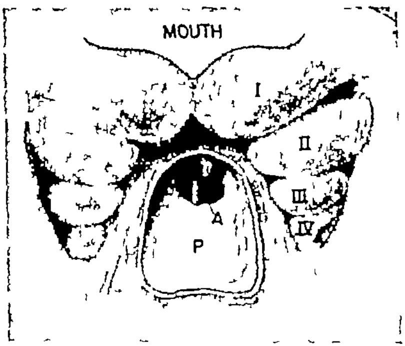

Fig 5 Somewhat Simplified View from Below of Structures forming Floor of Pharynx, the Pericardium being removed except where it is attached to this floor (P) to show the Structures of the Epipericardial Ridge (interrupted lines) passing Forward to the Mandibular Arch.

A. Aortic stem piercing pericardial roof

Redrawn from Frazer "Manual of Embryology"

Frazer showed that the cervical sinus is not completely enclosed, but rather that the third and fourth arches form the floor of a small depressed triangular field (see Fig 4-A) The anterior border is formed by the hyoid arch, the posterior border is a thick ridge produced by downgrowths from the occipital myotomes The posterior border extends from behind and below the otocyst, down and back, and then becomes continuous at an acute angle with a smaller ridge which runs forward above the pericardium (epipericardial ridge) The epipericardial ridge extends medial and forward, so that it is lost to view between the third arch and the pericardium. It ultimately reaches the mandibular arch (see Fig 5) The epipericardial ridge carries muscle cells from the occipital (and probably upper cervical) myotomes to form the muscles of the tongue, infrahyoid muscles and at least part of the sternomastoid The hypoglossal nerve arising near the occipital myotomes grows forward with these muscle cells to reach the mandibular arch[2]

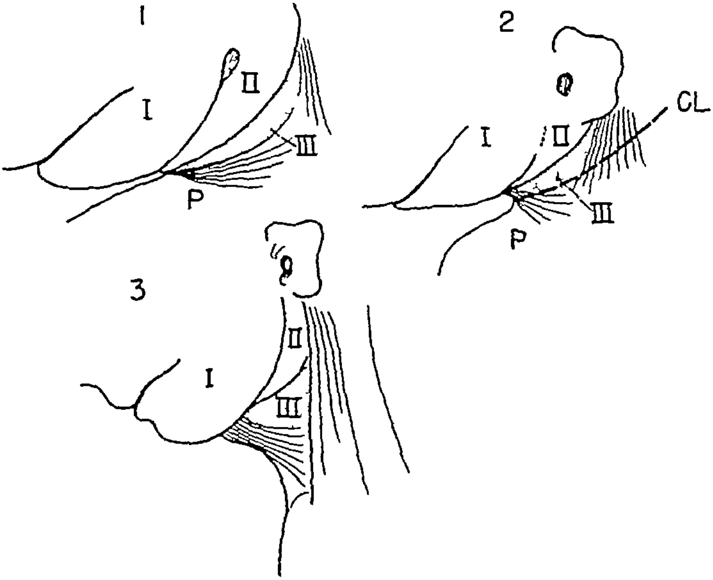

Fig 6 Three schemes illustrating formation of ventral part of neck The first shows the first three arches in position as at 12 mm with the muscle fibers sweeping round behind this to enter the epipericardial ridge The second shows a little more advance with distinction of fibers and the line (cl) in which the clavicle is beginning to form It will later have muscular attachments The third gives the definitive condition gained by the fixation of muscle to clavicle and the drawing forward of the neck beyond this

Redrawn from Frazer[8]

The placodal areas of thickened epithelium appear in association with nerves of the arches A week later all three borders of the triangular cervical field have encroached upon it, burying the fourth arch but leaving a recess leading to its placodal area (see Fig 4-B) The placodal areas remain

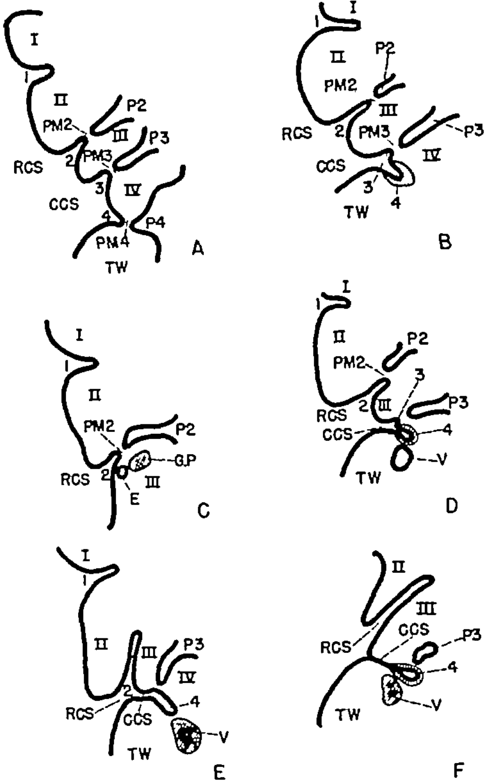

Fig. 7 Redrawn from photomicrographs of Garrett.*

A. Human embryo (6 mm) Section through the pharyngeal region showing the primitive relationships between branchial arches (Roman numerals) clefts (Arabic numerals) and the tips of the corresponding pharyngeal pouches (P 2 3 4) x 5

B. Human embryo (8 mm) A similar section showing the thickening of the walls of the fourth cleft (4) the regression of the third cleft (3) and the narrowing of the cervical sinus (CCS RCS) x 5.

C. Human embryo (8 mm.) A section through the same embryo 0 90 mm nearer the brain showing an early stage (E) in the formation of vesicle 2 x 5.

D Human embryo (9 mm.) Section similar to those of Figs 1 and 2 showing narrowing and deepening of the fourth cleft (4) disappearance of the third cleft (3) and further constriction of the cervical sinus (CCS, RCS) x 52

E. Human embryo (10 5 mm.) A similar section showing modification of the fourth cleft (4) and constriction of the cervical sinus (CCS RCS) x 5.

F Human embryo (1 mm.) Shows the closure of the fourth cleft, transforming it into vesicle 4 (4) by obliteration of the caudal portion of the cervical sinus (CCS) x 52

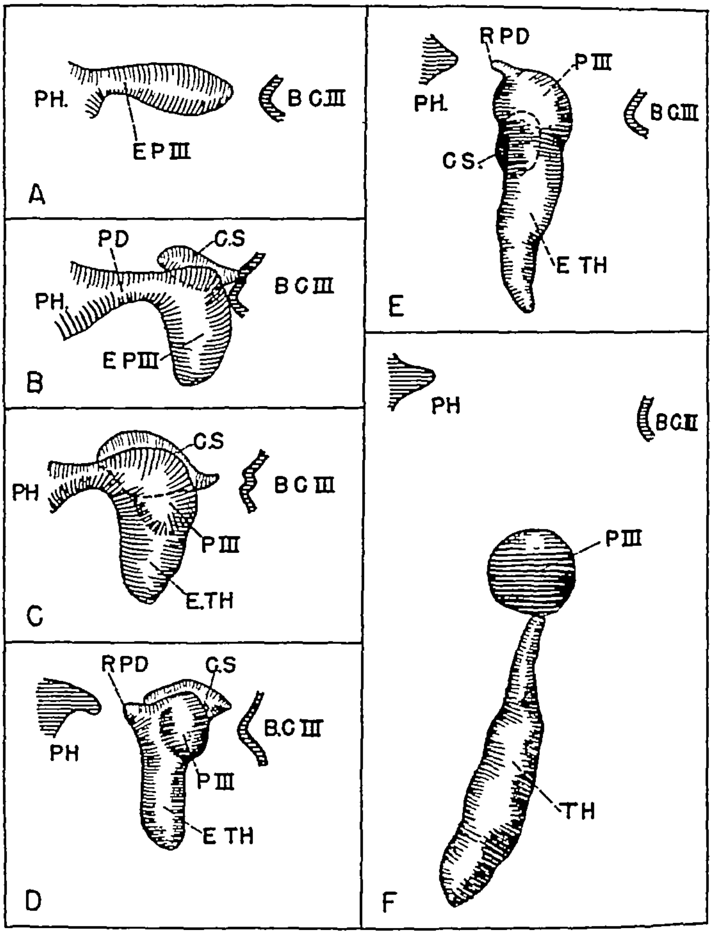

Fig 8 Schema of the morphogenesis of the third branchial pouch and its derivatives seen from ventral

A Third branchial pouch approaching the floor of branchial cleft III

B Elongation of third pouch into the primordium of the thymus Early association of the cervical sinus with the thymus

C Appearance of the primordium of parathyroid III at the cephalic end of the pharyngeal pouch Separation of ectodermal sinus Its dorsal relation to the upper end of the thymus

D Complete separation of third pouch derivatives from the pharynx

E Growth of parathyroid III and elongation of the thymus beginning of isolation of third branchial complex components

F Caudal migration of thymus B C III Branchial cleft III C S Cervical sinus E P III Third entodermal pharyngeal pouch E Th Entodermal thymus P III Parathyroid III P D Pharyngo-branchial duct Ph Pharynx R P D Remnant of pharyngo-branchial duct. Th Thymus

(Redrawn from illustrations by E Erickson in article by Norris 1937 Courtesy Carnegie Institution of Washington) ** connected with the ganglia of their respective nerves, and as growth goes on and the nerves get further from the surface the placodes are left at the bottom of little pits opening on the surface. These disappear very soon.

By the end of the seventh week (12 mm. stage) the fourth arch is covered by the occipital fold The third arch can be seen on the surface, its groove represented by a faint line (see Fig 4 C), in the upper part of which is still a connection, the placodal vesicle of the vagus. This arch is clearly marked off in front, for the line of the second outer groove remains as the flexure line of the neck. Thus the "closure" of the cervical sinus is only partial, the third arch remaining flattened down on the surface.

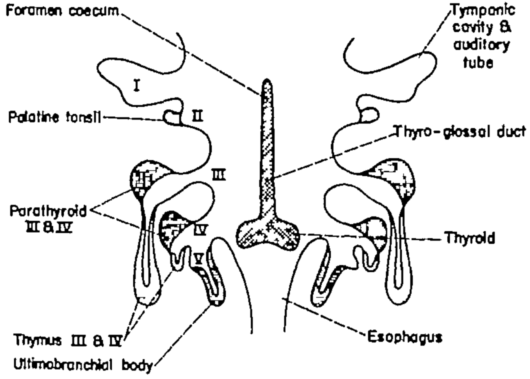

Fig 9 Diagrammatic outline of the pharynx, at about the stage of 10 mm., to indicate its derivatives. I V Pharyngeal pouches.
Redrawn from Arey Development Anatomy [10]

The second arch now becomes appended to the first by virtue of fusion of the walls of the first groove The upper part of this groove remains as a wide and deep hollow to form the external auditory meatus (see Fig 4-C) with the wing-like remnant of the second arch forming the lower part of the pinna

The pharynx in the meantime has been slowly growing away from the pericardium so that the area between the pericardium and the mandibular arch (see Fig 5) is gradually enlarged with the cells of the epipericardial ridge filling up the interval Here the muscle cells of this ridge come into contact with the body of the hyoid bone formed between the ventral parts of the second and third arches (*hyoid muscles*)

The neck comes into evidence as the pharynx separates from the pericardium The large mandible has the remnant of the second arch (part of the pinna) attached to it, but on a deeper plane are the digastric and stylohyoid muscles, which maintain the original position of this arch Behind them is the flexure line of the neck, and then the area which was originally the external third arch which now enlarges to extend over the

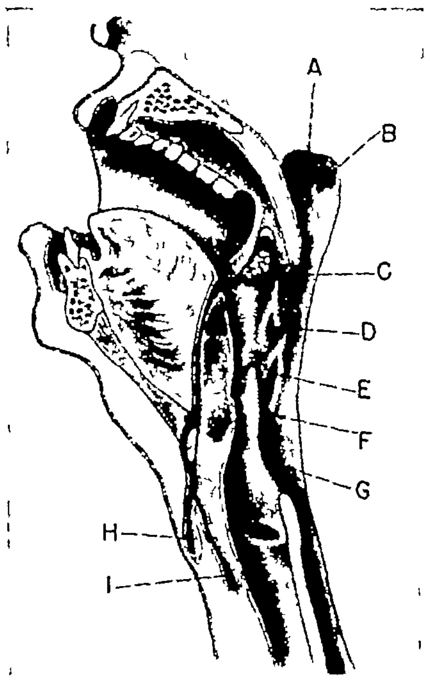

Fig 10 Diagram showing the position of pharyngeal pouches in the human pharynx A Eustachian tube (first pouch) B. Lateral recess of nasopharynx (fossa of Rosenmueller), C Tonsil (second pouch) D Position of third pouch according to Keith (73) E Position of third pouch according to Arey (2) F Elevation over internal laryngeal nerve G Position of fourth pouch according to Arey (2) H Median thyroid stalk forming cyst and fistula I Median thyroid forming isthmus

anterior triangle of the neck This is bounded ventrally by infrahyoid muscles, and behind by the sternomastoid, derivatives respectively of the epipericardial structures and the caudal limiting ridge (see Fig 6)

In an earlier report Frazer depicts the cervical sinus drawing away from the pharynx with continued growth, leaving long cell strands of ectoderm in contact with the pharyngeal pouches (see Figs 14, 15) The cervical sinus is connected to the external surface by a narrow tract. The external duct running from the region of the second pouch opens into this tract and not directly into the cervical sinus.

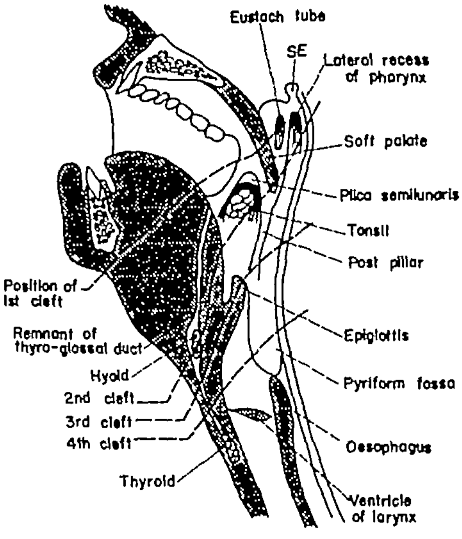

Fig 11 Showing the position of the Visceral Clefts in the adult. The lines only indicate the approximate positions of the clefts. For instance the soft palate is made up largely from the third arch SE = median pharyngeal recess or bursa.

Redrawn from Keith "Human Embryology and Morphology"

ENTODERMAL ASPECT AND THE PHARYNGEAL POUCHES

The pharyngeal pouches have disappeared from the interior of the pharynx by the end of the second month, with the exception of the upper part of the first, which forms the Eustachian tube, tympanic cavity and mastoid air-cell system. The external auditory meatus is formed from the first groove The tympanic membrane remains in the position of a cleft or closing membrane The lateral pouches have dorsal and ventral angles, and the surface of contact with the ectoderm extends from one angle to the other[1] (see Fig 14) In the case of the first pouch there is no definite ventral angle, and the epithelial contact is only with the upturned dorsal angle

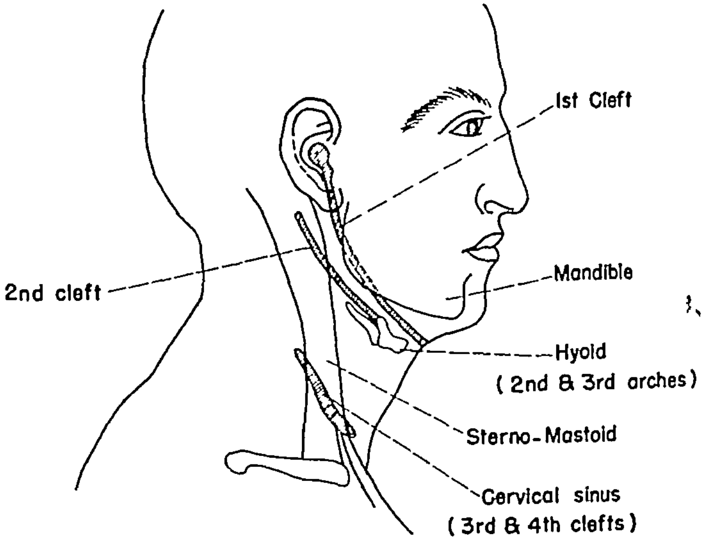

Fig 12 Showing the position of the External Cleft Depressions in the Adult
Redrawn from Keith 'Human Embryology and Morphology[7]

The second pharyngeal pouch is obliterated ventrally by the development of the tongue and by a proliferation of its endodermal lining Only a small portion may persist as a small recess (tonsillar fossa) The dorsal portion of this pouch may contribute to the corresponding tubo-tympanic recess[2] The distance between the angles in the depth of the second pouch increases rapidly, the upper angle and the pouch below it lose contact with the ectoderm and come to lie permanently in the middle ear[1] (see Fig 14) The lower or ventral angle of the second pouch is located in the tonsillar fossa

The pyriform fossa, anterior to the fold of the internal laryngeal nerve, marks the site of the third pharyngeal pouch in the adult. The fourth pharyngeal pouch opening site lies behind the fold over the internal laryngeal nerve[4] (see Fig 10)

PATHOLOGICAL CONSIDERATIONS

The pathogenesis of lateral cervical cysts and fistulas still remains widely disputed chiefly because of the various opinions concerning the embryonic development of the neck

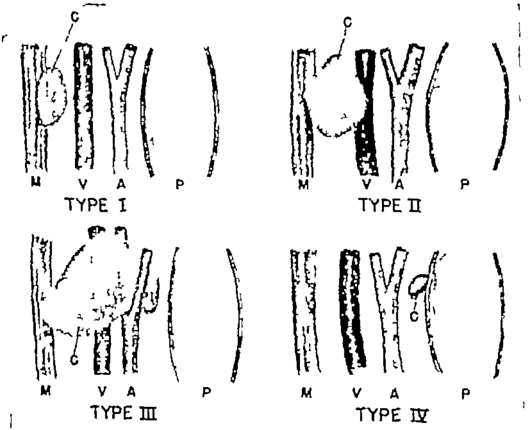

Fig [illegible] Diagrams showing the relationship of Branchial Cysts to the surrounding structures They are of four types
Redrawn from Bailey "Branchial Cysts

Most authorities adhere to the branchiogenic theory on the basis of one of the following •

1 Vestigial remains (epithelial rests) of the branchial apparatus.

2 Incomplete closure of the branchial grooves

3 Rupture of the closing membrane separating the branchial grooves from the branchial pouches

4 Anomalous development of the branchial apparatus

5 Persistence of a cervical sinus

It is usually assumed that fistulas are the result of incomplete closure of a branchial groove or pouch, or both, and that cysts are a result of vestigial epithelial remnants (see Figs. 11, 12, 16, 17, 18)

Bailey[6] has described four types of branchial cysts based on their relations to surrounding structures (see Fig 13)

Type I — This is the type which lies superficially immediately beneath the cervical fascia and at the anterior border of the sternomastoid muscle

Type II — This is the commonest variety It is beneath the enveloping fascia It extends down to and lies on the great vessels The wall must be carefully separated from the internal jugular vein to which it is varyingly adherent Fascial pressure causes them to become oblong

Type III — Extension inward to the lateral wall of the pharynx occurs The cyst passes between the internal and external carotids In addition a prolongation of the cyst may pass upward as far as the lateral mass of the atlas and even to the base of the skull The overlying portion of the sternomastoid muscle is thinned and flattened out over the cyst.

Type IV — This is usually a columnar-lined cyst lying adjacent to the pharyngeal wall, and medial to the carotids As a rule this type is seldom observed clinically, since it lies deeply and usually produces no symptoms At times these cysts develop after tonsillectomy as the post-operative scar closes a previously patent and unnoticed internal incomplete branchial fistula

Frazer[5] was of the opinion that Bailey's *Type I* originated from the external tract leading to the cervical sinus or from the second external duct which runs into this tract (see Fig 14) *Type II* is ascribed to an enlargement of a persistent cervical sinus *Type III* is referred to as an enlargement of the second external duct perhaps combined with an enlarged cervical sinus *Type IV* may be the remnant of an internal pharyngeal duct, or may possibly be derived from one of the "epithelial bodies" which are found in association with the pouches, or, in spite of its epithelium it may be derived from ectoderm

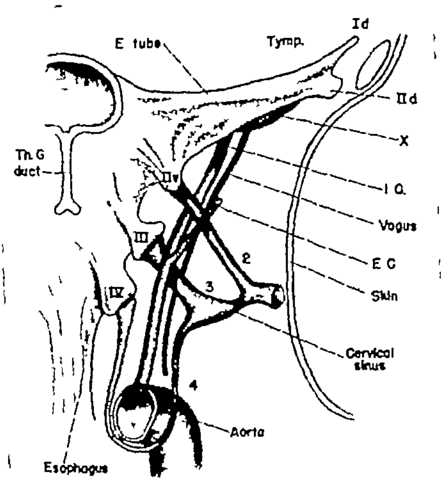

Fig 14 Schematic figure to show the vestigial structures in the neck with their relations to main arteries and nerves. The epithelial bodies are not represented. Id IId dorsal angles of 1st and 2nd lateral pouches. IIv, III, IV "internal pharyngeal ducts" derived from ventral angles of 2nd, 3rd and 4th lateral pouches. 2 3 4 external pharyngeal ducts derived from 2nd 3rd and 4th external grooves. X. Layer of entodermal cells cut off from the lower part of Eustachian tube E. Tube Eustachian tube. E.C External carotid. I C Internal carotid Th G Duct. Thyroglossal duct.

Redrawn from Frazer

According to Frazer,[1] there is only one way of settling the origin of any particular instance of persistent and enlarged vestige, and that is by a careful anatomical examination with reference to relations, followed after removal by microscopic investigation The anatomical relations are most important in their pharyngeal aspects "The three pouches and their corresponding external ducts bear definite and distinct relations to the main vascular and nervous structures, and these relations, if the vessels are normal, are absolutely fixed and certain" (see Fig 14)

It will be observed that the second external duct passes between the two carotids and in front of the vagus The third

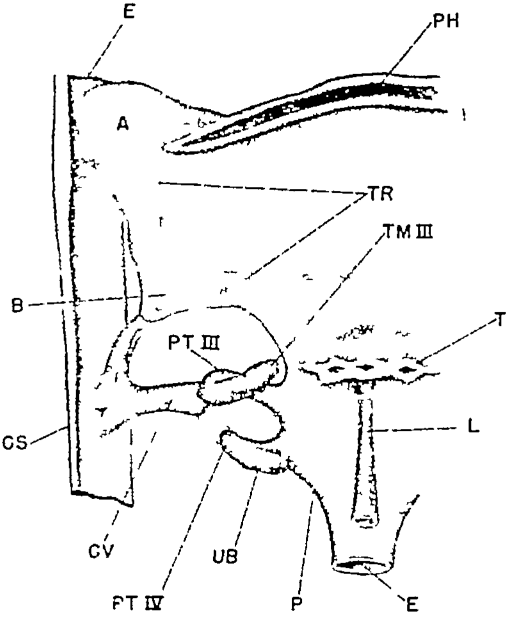

Fig 15 The Lining Membrane of the Pharynx of a Human Embryo at the end of the sixth week of development (10 mm) viewed on its ventral aspect (Grosser) E Ectoderm A First pocket B Second pocket (tonsil) CS Cervical Sinus CV Cervical vesicle PT IV Parathyroid IV UB Ultimobranchial body (thyroid) E Esophagus L Larynx P Pyriform fossa T Thyroid TM III Thymus III PT III Parathyroid III TR Tubotympanic recess PH Pharynx

Redrawn from Keith Human Embryology and Morphology [7]

external duct goes behind the common or internal carotid and in front of the vagus and reaches the interior of the pharynx below the hyoid The fourth external duct is drawn down by the arch of the aorta on the left side and by the subclavian on the right If the closing membrane were perforated these ducts might lead into the pharynx, the second into the tonsil, the third into the pyriform fossa anterior to the fold of the internal laryngeal nerve, and the fourth into the pyriform fossa behind the fold of the internal laryngeal[4] (see Figs 10, 11, 12)

The cervical sinus lies superficial to the great vessels, anterior to the sternomastoid and below the posterior belly of the digastric. Fistulas of the second groove, or cleft, and pouch have been recognized on many occasions. The ectodermal derivatives might be expected to have a stratified cell lining and the entodermal prolongations a columnar celled epithelium. Frazer states that lymphadenoid tissue of the walls of cysts may presumably be thymic.[1] In some lower mammals a “superficial thymus is found in association with the ectoderm of the cervical sinus.

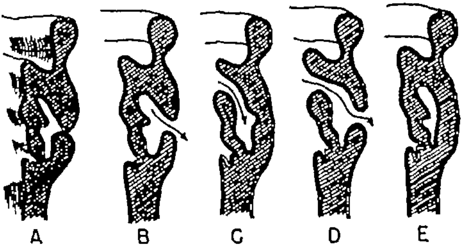

Fig 16 Series of diagrams to show how several kinds of tracts and cysts may arise through faulty development of the pharyngeal wall

A. Normal pharynx showing closure of cervical sinus.

B. Incomplete closure of cervical sinus forming the basis for a tract opening externally upon the surface of the neck

C. Rupture of closing membrane leaving permanent opening into the position of the second pouch

D Branchial fistula resulting from a combination of the conditions in B and C.

E. Cystic remnant of the cervical sinus

Redrawn from Ward and Hendrick “Tumors of the Head and Neck[18]

An interesting observation of Frazer's is the presence of a double layer of entodermal cells cut off from the lower aspect of the Eustachian tube (see Fig 14) “It is the result of the same process which has separated the dorsal and ventral angles of the second pouch A forward growth from the third arch destroys this portion of the second pouch and comes up against the first groove, which is caught between it and the first arch" This double layer of entodermal cells disappears quickly The possibility of its persisting as a vestigial remnant is suggested by Frazer It would lie below the Eustachian tube, behind the tensor palati and in front of the carotid and stylopharyngeus "If by any chance it opened into the pharynx, it would do so through the sinus of Morgagni"[1]

Keith indicates that if there is a residual of placodal or of any developmental pocket it should appear along the anterior border of the sternomastoid He further states that the cutaneous opening often contains a tag of skin representing a rudimentary external ear containing a piece of cartilage. The dorsal part of the second cleft may persist, an auricle becoming developed on it, while the normal external ear is suppressed[2]

The sources for vestigial remnants in the neck are the placodal cysts and their ducts, persistence of one or more of the ectodermal "external pharyngeal ducts" which are connected with the entodermal pouches, and abnormal fusion between the walls of the second groove in some parts of its extent Every vestigial remnant in the lateral neck that has a deep connection as well as an outer opening passes upward to cross the hypoglossal nerve before running to its original deep attachment[8]

Fistulas of branchiogenic origin are divided into three types (see Fig 16)

1 Incomplete external fistula — has an external opening but no internal communication with the pharynx

2 Incomplete internal fistula — opening into the pharynx but not externally

3 Complete fistula — complete tract with both internal and external openings

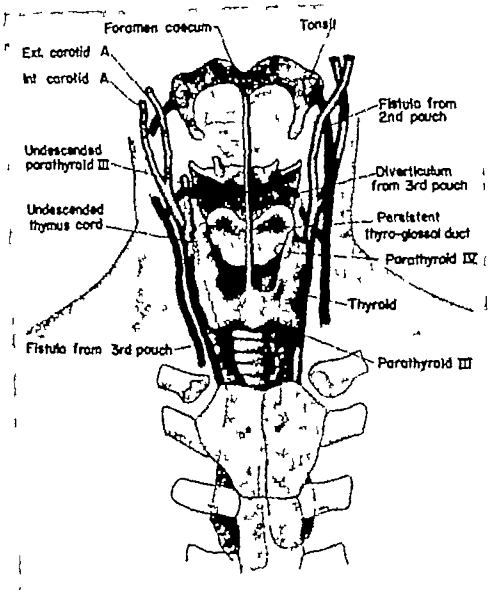

Fig 17 Schematic diagram in which is collected a number of anomalous conditions resulting from the faulty development of the cervical sinus, pharynx, and glandular derivatives of the pharyngeal epithelium. On the subjects right note undescended parathyroid III residual thymus cord and a branchial fistula from pharyngeal pouch III A previous connection of the fistula with a diverticulum of the supratonsillar fossa is broken Center, persistent *thyroglossal* duct passing ventral to (or through) the hyoid bone On the subjects left note a diverticulum of pouch III an incompletely descended thymus still attached to parathyroid III and a fistula of second pouch origin.

Redrawn from Braus "Anatomie des Menschen Bd 2.

The embryonic thymic duct may give rise to persistent anomalies[*] A fistula of the second groove can be distinguished from a fistula of the thymopharyngeal duct on the following basis

1 A fistula of the second groove must pass between the internal and external carotids Most complete fistulas do this. A fistula of the thymopharyngeal duct does not pass between the carotids but lies anteriorly to and very close to the carotid sheath Very few, if any, complete branchial fistulas do this.

2 The internal opening of a second groove fistula is in the tonsil fossa[10] The internal opening of a thymopharyngeal duct fistula is into the region of the pyriform fossa which very rarely occurs

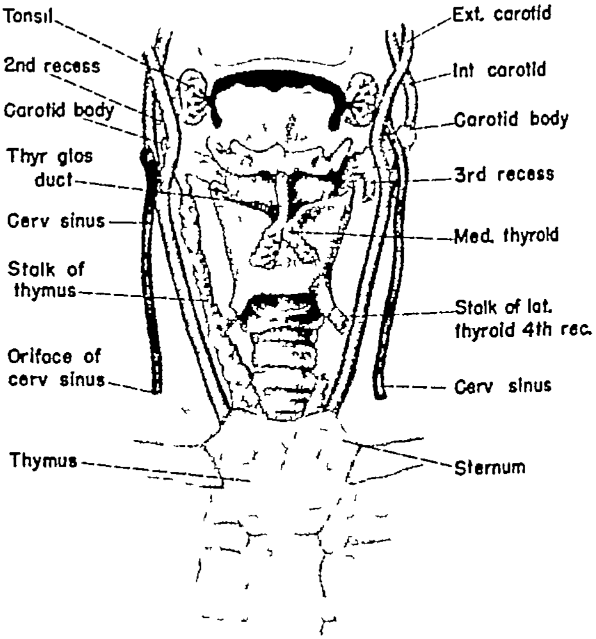

Fig 18 Diagram to illustrate the various parts of the visceral recesses and grooves which may persist The second recess gives rise to the tonsil the recess may be in contact with an epithelial tube derived from the cervical sinus The third recess gives rise to the thymus and parathyroid III The carotid body arises at the site of the third recess but its development has nothing to do with the recess

Redrawn from Keith Human Embryology and Morphology[7]

3 The location of the external opening is not of value in differentiating the two types, since either can open along the entire anterior border of the sternomastoid muscle

4 If a cyst wall contains typical thymic tissue with Hassall's corpuscles it may be of thymopharyngeal duct origin These are rare There is a possibility of thymic remnants in the neck becoming associated with a second groove fistula If a cyst or fistula does not contain thymic tissue in its walls it is probably of branchiogenic origin

5 Both types contain lymphoid tissue elements

6 Most cysts and fistulas contain squamous epithelium Some contain columnar or ciliated epithelium There is no reason why a thymic tract should contain a squamous epithelium

7 If the remnants of a thymic tract are responsible, cystic structures should occur anywhere from the final resting place of the thymus to the site of its origin.

8 The relationship of complete branchial fistulas to the stylopharyngeus muscle is rather vaguely reported The stylopharyngeus is a derivative of the third arch It is directed downward much more than forward, it is a thin, narrow and long muscle which requires meticulous dissection to distinguish it from the other muscles in the region Theoretically a second groove and pouch fistula should pass anterosuperiorly to this muscle on its way to the supratonsillar fossa

9 Branchial structures may occur above the hyoid bone and above the jaw It would be difficult to explain the constant occurrence of lymphoid tissue, presumed by Wenglowski to come from the thymus, in the walls of fistulas and cysts in these locations.[11]

10 It is difficult to explain the inconstant position of the external openings of fistulas and the relatively high locations of most branchial cysts with Wenglowski's theory [11]

LATERAL CERVICAL OR BRANCHIAL CYST

History and Symptoms

The most common symptom is a painless swelling in the neck (see Fig 19), usually below the angle of the jaw and along the anterior border of the sternomastoid muscle The swelling may become quite large before it is noticed This is probably because the swelling is gradual as a rule Occasionally the swelling is rapid particularly after an injury to the neck. Not infrequently the patient states that the swelling varies in size from day to day This is most likely due to absorption of the cystic fluid through the walls of the cyst In a few cases there may be a communication into the pharynx through which the cystic fluid may escape Some patients state that the cyst

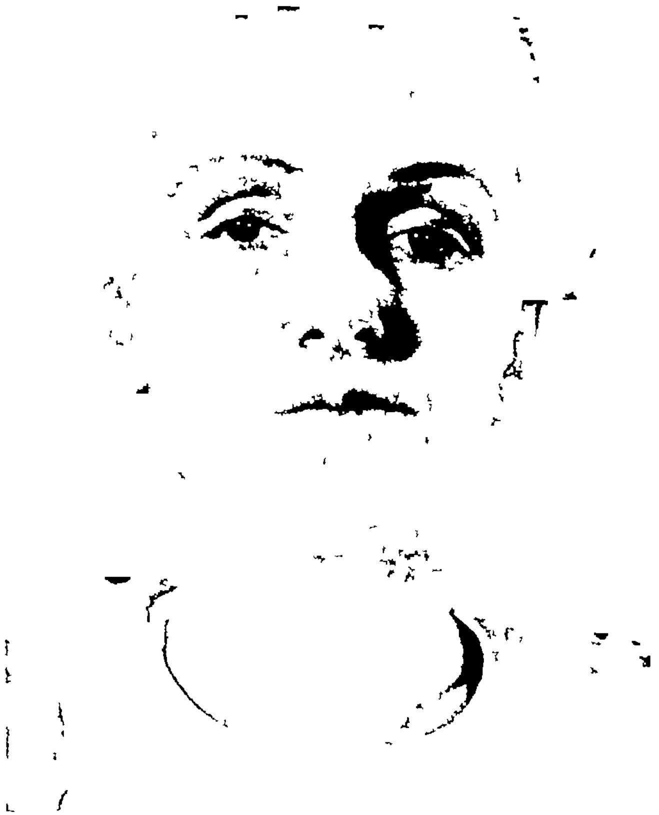

Fig 19 Typical appearance of the usual branchial cleft cyst

becomes tense at times, and it is in this group that some pain may be noted

Very large cysts may give rise to a sensation of pressure, fullness or drawing These may have dysphagia, huskiness and bulging into the floor of the mouth They rarely bulge into the pharynx.

Males and females are almost equally affected The ages vary from extreme youth to old age There is a familial tendency to branchial cysts.

PHYSICAL SIGNS.

The size of the cyst varies from that of an olive (1 5x2 5 cm.) to the size of a large orange (10 cm) The actual size of a cyst cannot always be ascertained clinically

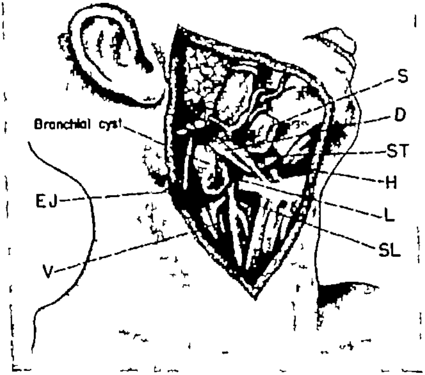

Fig 0 Drawing of a usual branchial cyst with its normal relations. S Submaxillary gland D Digastric muscle ST Stylohyoid muscle H Hypoglossal nerve L Lingual artery SL Superior laryngeal nerve. V Vagus nerve EJ External jugular vein.

The swelling is cystic, and fluctuation is usually elicited In large tense cysts which have thick walls, cheesy contents, and are deep seated, this sign may be absent. In these cases this sign may again be sought for by having the swelling fixed" by an assistant and manipulating in two planes at right angles to each other

Cysts are usually not translucent. Occasionally a cyst originating from a pharyngeal pouch lined by columnar epi thelium, filled with mucus, and having reached a large size may become translucent Cysts are movable, not fixed to underlying structures and skin, regularly outlined, and covered with smooth skin unless there has been considerable inflammatory reaction around the cyst.

Cysts lie in relationship with the deep surface of the upper half of the sternomastoid (see Fig 20) It nearly always protrudes around the anterior border of this muscle and rarely around its posterior border Its center usually is opposite the great horn of the hyoid The sternomastoid is frequently thin and flattened out over a cyst, so that it is difficult to palpate One can overcome this by standing behind the patient and asking him to push his chin as hard as possible against your palm This tightens the sternomastoid so that it can be palpated from low in the neck (where it is normal) upwards along its anterior border

DIFFERENTIAL DIAGNOSIS

With a complete examination and with an adequate working knowledge of the various pathological lesions in the neck the clinician can diagnose a large percentage of branchial cysts Frequently, however, the final diagnosis must be made by the pathologist.

Tuberculous Lymph Glands — Tuberculosis in the cervical lymph nodes frequently simulates a branchial cyst The contents of a cold abscess frequently look like the contents of a cyst Bailey[6 12 13] claims that tubercle bacilli are found in only 10 per cent of tuberculous glands The contents of both cavities, then, are usually sterile All groups of cervical lymph nodes should be palpated from behind the patient whose head is bent forward The complete absence of cervical adenitis is in favor of the swelling being a branchial cyst It is unlikely, but not impossible, that a tuberculous abscess would exist for many months without involving the skin.

Cystic Hygroma — A cystic hygroma is translucent while a branchial cyst is opaque The former, usually located in the lower half of the neck, is diffuse, loculated and first noted in infancy A branchial cyst is well circumscribed, unilocular and is usually located in the upper part of the neck

Solitary Lymph Cyst—These are invariably translucent and located in the supraclavicular triangle These are probably related to cystic hygroma but usually appear in adult life.

Hemangioma and Lymphangioma—The cavernous hemangioma is bluish in color and presents a "bag of worms" sensation on palpation, due to the enlarged tortuous veins Bailey* suggests using the "sign of emptying" If the cystic swelling is a venous hemangioma then pressure will cause it to decrease in size and when pressure is removed it slowly refills It is possible for a large branchial cyst with deep ramifications to give this sign by emptying into the retropharyngeal space, hence, when exerting this pressure, the pharynx should be watched before pronouncing the "sign of emptying" positive

Cystic Degeneration of a Malignant Neoplasm—A rapidly growing primary or metastatic malignancy in the "branchial position" may become cystic.

Carotid Body Tumor—Branchial cysts are much more common These tumors occur at the carotid bifurcation They move laterally but not vertically Pulsation is usually transmitted It is important to distinguish between these two lesions because removal of a carotid body tumor is associated with tremendous risks.

Dermoid Cyst—These contain hair They are superficial and are never attached to the lateral pharyngeal wall

Primary Lymphomas—This may lead to confusion, especially if there is only one enlarged node The lymphomas are rarely single and often appear as a group of fused, adherent nodes. Lymphomas are apt to be firmer than branchial cysts.

Aberrant Thyroid—These may occur at any level from the hyoid to the suprasternal notch. They vary in size from 1 to 5 cm. In general they are firm, mobile and are not cystic

Neurofibroma—These are occasionally seen in the neck. They may present a rather firm tumor that is immobile and varies from 1 to 4 cm in diameter They may or may not be multiple.

Aneurysm — Aneurysm of the carotids usually bulge into the pharynx They do not necessarily transmit a pulsation since the pulse pressure is low within Aspiration with a fine needle would confirm the diagnosis If in doubt carotid arteriography would be diagnostic

Lipomas — These fatty tumors are frequently lobulated and may suggest a branchial cyst Aspiration of course would not yield fluid

Suppurative Cervical Lymphadenitis — Acute inflammation of a branchial cyst may simulate a suppurating cervical lymph node The history of a previous swelling in the neck would speak for a branchial cyst.

Chronic Retropharyngeal Abscess — Especially in cases of tuberculosis A branchial cyst may present in the pharynx, extend up to the atlas and outward to the great vessels[14]

Thyroglossal Duct Cyst — These need not be in the midline. They are often on the left side but not so far laterally as the sternomastoid They are attached to the hyoid and will move up and down with swallowing

Myxomatous Degeneration of a Mixed Parotid Tumor — An intraparotid branchial cyst was described by Fredet[15] and by Cunningham[16] These evidently arose from the first cleft

Accessory Thymus — These are rare remnants found along the course of the thymopharyngeal duct They may be associated with aberrant parathyroid tissue[17]

PATHOLOGY

The contents of a cyst lined by squamous epithelium is an opaque fluid which passes readily through an aspirating needle. If this fluid is placed in a dish and moved to and fro the shimmer of its lipoid contents will be noticed[6] If the fluid is dropped on a slide and covered with a cover-slip and examined under low power, numerous cholesterol crystals will be seen, which is characteristic of these cysts At times the contents of a cyst consists of a cheesy material suggesting tapioca granules[18]

Those cysts lined with a columnar epithelium have a thick, sticky, mucoid fluid which is transparent.

Microscopic Pathology—Microscopically branchial cysts usually have a stratified squamous epithelium, which is surrounded by lymphoid tissue and a layer of loose connective tissue In 263 of the 287 specimens reported by Neel and Pemberton the lining was a squamous cell epithelium In 18 cases it was columnar and in six cases both types of epithelium were represented The columnar epithelium may contain cilia (see Fig 22) The supporting layer of connective tissue in these cysts occasionally contains serous glands and muscle tissue Evidence of chronic inflammation is almost always present in the walls of these cysts Accidental or intentional incision of a cyst is likely to result in an acquired branchial fistula. Occasionally a cyst is reported to contain thymic tissue in its wall Such a cyst was reported by Rudberg[19]

BRANCHIOGENIC CARCINOMA.

Many authorities are of the opinion that branchiogenetic carcinoma does not exist. This diagnosis can be considered only after a thorough search of the mouth, nasopharynx, tonsil larynx, hypopharynx and external auditory canal Crile and Kearns[6] stated that less than 100 cases had been reported up to 1935 In the large series of branchial cysts (287 cases) reported by Neel and Pemberton[21] they found no suggestion of carcinoma in any specimen.

TREATMENT

The only treatment that will effect a cure is complete surgical excision. In the event of acute suppuration surgery must be delayed until the inflammatory reaction has subsided If the suppuration does not immediately respond to conservative measures incision and drainage might be necessary leaving the ultimate excision to a later date.

The use of sclerosing solutions, repeated aspirations and X-ray therapy are mentioned only to be strongly condemned They seldom produce a cure, and they cause unpredictable inflammatory reactions, which make subsequent surgical extirpation much more difficult.

The cyst is exposed through a single transverse incision following the line of the creases in the neck. The incision should be near the middle of the cyst and the flaps of skin and platysma dissected from the underlying enveloping fascia If the cyst is unusually large the sternomastoid muscle may be divided to afford proper exposure

The underlying spinal accessory nerve should be carefully isolated It bears a posterior relationship to the cyst wall The branchial cyst may run deeply in the neck and extend upward as far as the base of the skull It is highly desirable to remove the cyst intact If it bursts half way through the operation dissection becomes difficult, surrounding structures become endangered, and the end result may be unsatisfactory, for even a small piece of secreting epithelium left behind may give rise to a sinus which persistently discharges

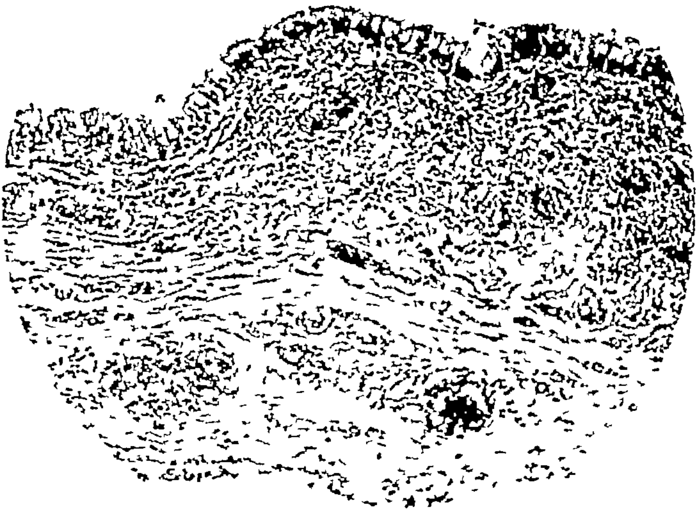

Fig 2. Photomicrograph of a branchial cyst which was found behind the posterior tonsil pillar Note the ciliated columnar epithelium

The following technique simplifies the operation and makes intact removal almost always possible The superficial aspect of the cyst is cleaned and about half of the liquid contents of the cyst aspirated with a small needle and saved for reinjection into the cyst after removal so as to check for the possibility of overlooking a fistulous tract. The puncture hole is then covered with a small piece of gauze which is then seized along with the underlying collapsed cyst wall, with a sponge forceps [6] The gauze helps to keep the forceps from slipping Gentle traction is made with the forceps in various directions, while the cyst wall is dissected out by blunt dissection with gauze, forceps or scissors Great care must be taken not to overlook a pedicle which must be removed along with the cyst.[22] The pedicle may extend to the tonsil fossa and may be so narrow that it is difficult to dissect. Extensive dissection may be required

LATERAL CERVICAL FISTULAS

The typical cervical fistula is present at birth and has its external opening a short distance above the sternoclavicular joint and in front of the sternomastoid muscle The fistulous tract is usually palpable as a firm cord which passes upward under the platysma muscle and enveloping fascia and superficial to the sternohyoid and sternothyroid muscles (see Fig 23) The course parallels the sternomastoid muscle It is in close relation with the underlying carotid artery and internal jugular vein. At the level of the hyoid bone it turns inward, crosses over the hypoglossal nerve, passes beneath the posterior belly of the digastric muscle, passes between the internal and external carotid arteries and over the glossopharyngeal nerve. It then passes beneath the styloglossus muscle and above the stylopharyngeous muscle. It finally extends upward along the posterior aspect of the tonsil into the posterior palatine arch to end in the upper half of the posterior faucial pillar, the supratonsillar fossa,[23 24 25,26 27] or it may extend through the tonsil opening directly on its surface [19 21 22 20]

According to Rudberg[19] about 90 per cent of fistulas show squamous epithelium, 8 per cent ciliated columnar, and 2 per cent show both types. When the lining is columnar there is often a persistent, annoying secretion of mucus [6] When the fistula is of a uniformly large caliber ingested liquids may leak through If the fistula is of thymogenic origin then thymic tissue will be found along it,[9, 23] on microscopic examination

Many times the external orifice is small and inconspicuous.

In the series of 239 cases of lateral cervical cysts and fistulas reported by Neel and Pemberton[21] 80 were fistulas Of these 40 were external fistulas, 31 complete fistulas and nine internal fistulas Fifty-eight complained of a draining sinus The majority of external fistulas were produced by ill-advised incision of a cyst (acquired fistulas) which was mistaken for an abscess Semken[30] stated that complete fistulas are present in approximately one-third of reported cases When a complete fistula is present the external orifice can be seen to rise with deglutition.

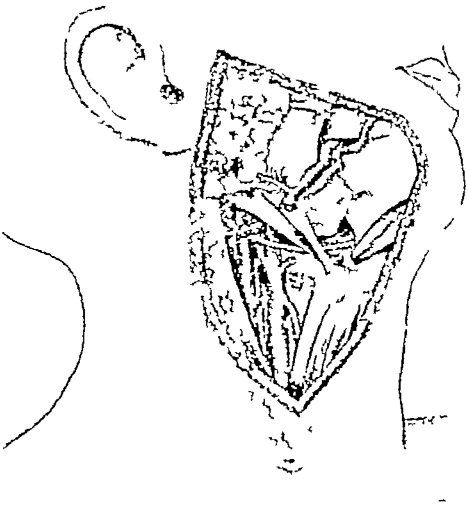

Fig 23 Drawing of a complete fistula of second groove and pouch origin with its usual relations Note the fistula passing upward under the sternomastoid muscle At the level of the hypoglossal nerve it bends almost at right angles over the nerve and between the internal and external carotids to reach the region of the pharyngopalatine arch a short distance further Not shown is the passage of the tract over the glossopharyngeal nerve and stylopharyngeus muscle which lie deep to the carotids

The internal opening of a complete or of an internal fistula can be found in only a small number of these cases If an internal fistula is associated with a cyst, the cyst may fill with food, air or liquids when swallowing, or it may become infected and fill with pus Pressure applied to such a cyst may express its contents into the pharynx. This situation is sometimes initiated by tonsillectomy [11, 31]

Fistulas may be unilateral or bilateral They may occur in several members of the same family [11, 31, 32] Fistulas occasionally have accessory tracts or diverticulums[11] which must not be overlooked in surgery When a fistula is probed such symptoms as pallor, palpitation, coughing, and vomiting may occur, due to the close proximity of the tract to the vagus nerve.[32, 3]

A fistula of the third pharyngeal pouch should open into the pharynx in the plane of the thyrohyoid membrane. These are extremely rare.

An internal fistula may open into the trachea or larynx and give rise to air sacs and present the features of what has been called "aerial goitre," "aerial bronchocele," "tracheocele,' and "hernia of the trachea "[18, 3] These should be differentiated from a laryngocele

A tuberculous fistula must be considered in the differential diagnosis The congenital fistula is present at birth whereas the tuberculous one is not. The course and extent of a fistula can be demonstrated by the injection of the tract with a radio-opaque oil and taking a Roentgenogram (see Fig 24) A congenital fistula will reveal a smooth wall whereas a tuberculous fistula will be very irregular[34] If the shadow extends to the pharynx a diagnosis of a complete fistula can be made.

TREATMENT

Total surgical extirpation offers the only sure cure Previous inflammatory reactions may make the dissection of a tract difficult. Orientation as to the extent of the tract may be facilitated by the injection of the tract with methylene blue and then washing it out with saline.[7] Enough dye remains on the wall to stain it but not enough to stain the operative [illegible] A blunt needle and a minimal of pressure is required for [illegible] injection The tract may be injected with liquid paraffin, which solidifies and makes the dissection easier [36] A catheter can be inserted into the fistula as a guide for dissection [3] McNeil Love[38] advocates a procedure whereby the orifice of the fistula is encircled with a fine purse-string suture which is

Fig 24 Case 29 Complete fistula injected with lipiodol Note upper fourth of the tract is narrow and communicates via a much narrower and shorter tract with a large dilated inferior portion Swinging laterally is a catheter

inserted as close to the orifice of the fistula as possible and then tightened to close the orifice In a few days continued secretion distends the fistula, transforming it into a cyst, which thus facilitates dissection The extent of the tract is determined by the injection of a liquid radio-opaque material (see Fig 24)[38] such as lipoidol under local anesthesia (infiltrated around the external opening) A purse-string suture

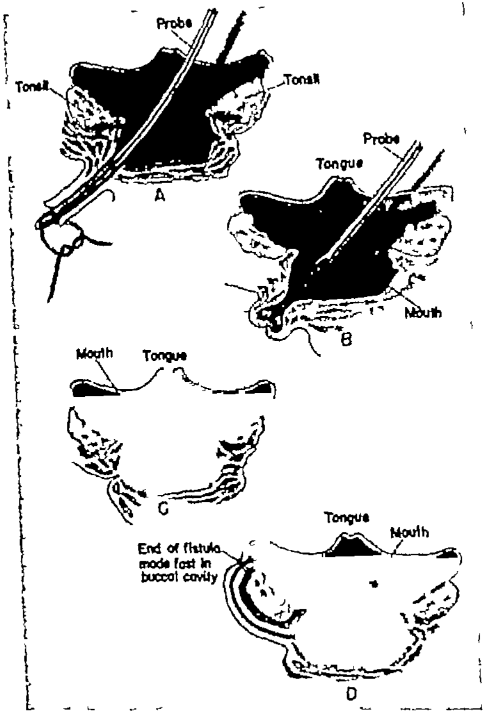

Fig 5 Cross Sections at *Tonsil Level* *Diagram* to show the steps in the von Hacker and Koenig operations. A. The dissected fistulous tract has been amputated and the stump has been made fast to the eye of the probe. B. Probe drawn into mouth and fistula being inverted. C. Tract has been entirely inverted ligated and cut off. D Procedure in the Koenig operation. The stump of the tract has been brought anterior to the tonsil and passed into the buccal cavity *where it has been made fast.*

Redrawn from Christopher [1]

is placed around the fistula before a blunt needle or catheter is inserted into the tract. As soon as the injection is completed the syringe and its attachment are withdrawn and the purse-string suture tied to prevent the escape of the radio-opaque material before the X-ray pictures are made

Sclerosing solutions have been advocated by some au

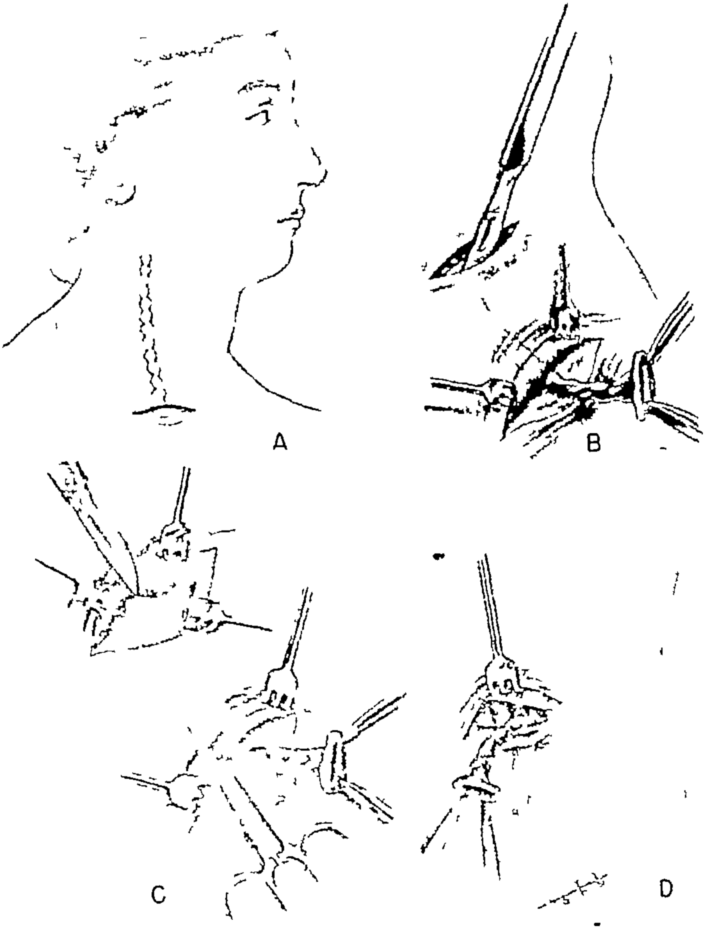

Fig 26 The step-ladder operation—A. Transverse incision about the external orifice of the fistula. B Tract partially freed and the second incision made at the hyoid level C Fistulous tract dissected from below up to the second incision The envesting fascia is cut D The fistulous tract is brought out through the second incision From this level the dissection is carried down to the termination of the fistula in the supratonsillar fossa Note the fistula passing over the hypoglossal nerve and inward between the carotids

Redrawn with modifications from Baumgartner[5] thors[40 41 42 43] Beck[41] used this method in treating fistulas in children It has an advantage because a scar is avoided The step-ladder technique, to be described later, leaves very little scarring, however With the injection treatment there is the danger of marked inflammatory reaction and necrosis with perforation into the pharynx and hence is not recommended

Von Hacker[44] described the following method of surgical removal (see Fig 25 A C) The orifice of the tract is circumscribed and the tract dissected upward through an incision along the anterior border of the sternomastoid Above the bifurcation of the carotid the tract is carefully followed between the carotids and below the digastric to the lateral wall of the pharynx through which it passes to the tonsillar region As it may be difficult to follow the course of the fistula between the carotids the tract may be opened at this site and a probe carefully inserted to locate the opening in the pharynx The probe is then advanced until it can be seized through the mouth. The fistulous tract is then fastened about the probe by means of a silk suture at a point central from the site of the perforation The probe is then slowly and carefully withdrawn through the mouth, the fistulous end fixed to the probe is slowly invaginated, and the fistula is loosened from its attachments The end of the fistula may in this way be brought through the pharynx without difficulty The rest of the tract is ligated with catgut near its base and resected above this ligature.

If the fistula cannot be dissected to the pharynx, perhaps as a result of previous inflammation Koenig's technique[45] (see Fig 25 D) may be used whereby the distal end of the fistula is brought into the buccal cavity in front of the tonsil so that the secretions drain into the mouth instead of externally

Koenig's operation is as follows The tract is dissected as high up toward the digastric as possible and then by blunt finger dissection another passageway to the pharynx is created. A probe is inserted through the neck wound into the depth of the new passage until it engages the mucosa as the base of the anterior tonsil pillar The mucosa at this point is incised and the probe is pushed through into the pharynx. The wall of the dissected branchial fistula is fastened to the fenestrated end of the probe with a suture and is drawn through the opening into the lumen of the pharynx It is thus led through, but not turned inside out, as in Von Hacker's operation The fistula is pulled tight and sutured to the mucosa The fistula projecting into the pharynx is cut off, leaving a short stump which curves around the base of the tonsil The original distal end of the fistula is in the supra tonsillar fossa, and the amputated anterior end of the fistula is in the newly made opening at the base of the anterior tonsil pillar Koenig's and Von Hacker's operations are recommended if the fistula is large If a stump is ligated and left in the wound a recurrence may take place in the form of an internal fistula which can discharge into the pharynx

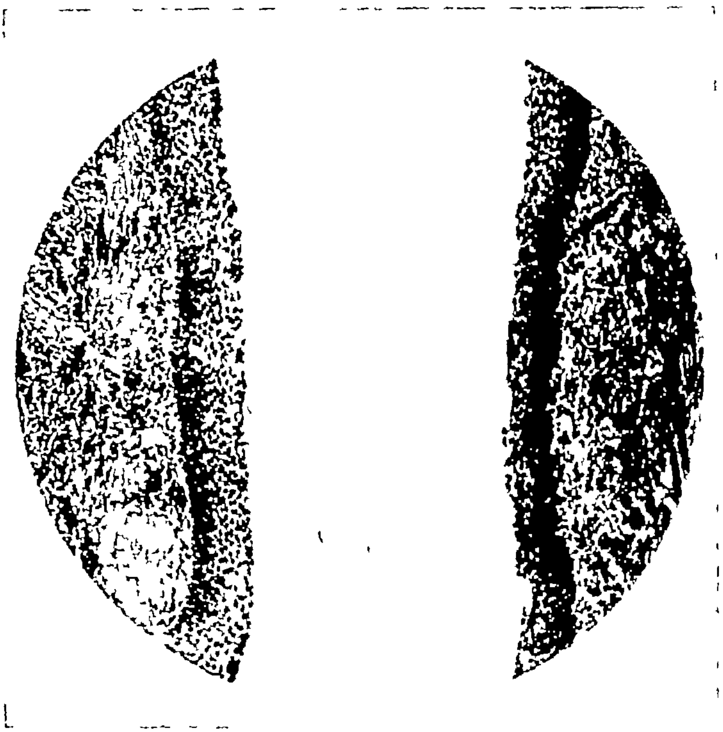

Fig 27 Photomicrograph of branchial fistula lined with stratified squamous epithelium

The most satisfactory operation for removal is the step-ladder technique[46,47] (see Fig 26) An elliptical transverse incision is made about the external orifice of the fistula Gentle traction is applied to the fistula while dissection is carried up beneath the skin, platysma muscle and fascia A second transverse incision is made over the fistulous tract at a higher

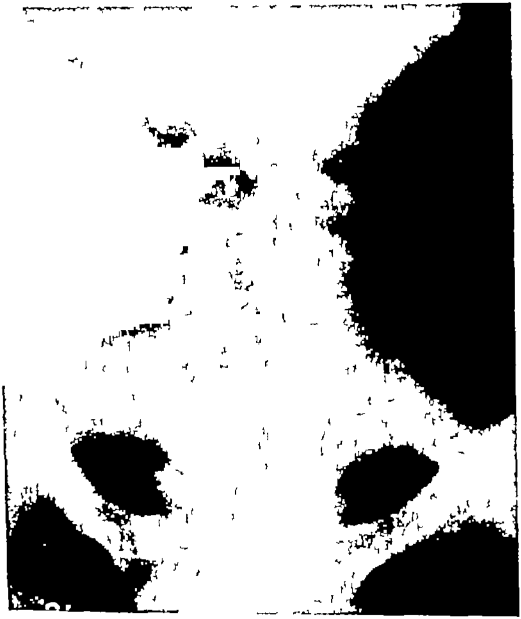

Fig 8 Laminogram of larynx showing position of branchial cyst of third branchial pouch origin (arrows)

level The tract is then threaded through from the first to the second incision and the dissection resumed from this second level until the tract is completely removed When the tract approaches the pharynx an assistant places a finger in Rosenmueller's fossa and presses down and laterally to facilitate fol-

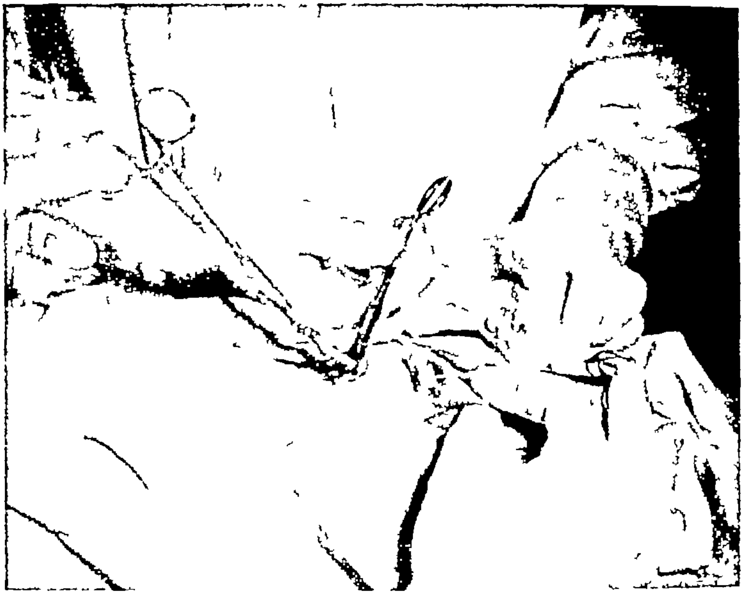

Fig 29 Showing the step-ladder technique in the case of a placodal fistula of the second arch Note the vestigial elevation on the posterior surface of the left auricle which is partly circumscribed by incision The transverse and elliptical incision lower in the neck is opposite the greater horn of the hyoid and includes abnormal skin around the lower orifice of the fistula The tract has been dissected upward where it was found to pass under the facial nerve to which it was firmly adherent. The tract was exposed again through another incision at a point intermediate between two incisions seen in the photograph After freeing the fistulous tract from under the facial nerve it was dissected upward and completely removed along with the fistula and tumescence on the posterior surface of the auricle

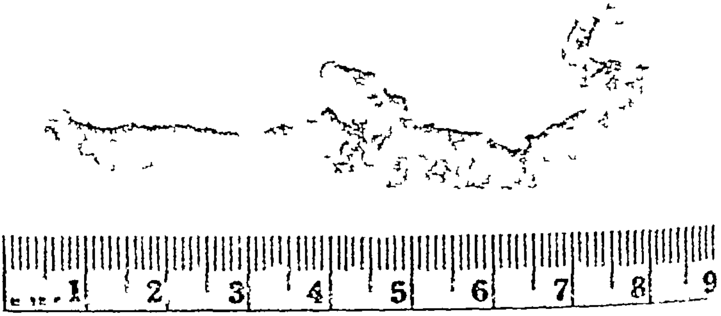

Fig 30 Photograph of fistulous tract the position which was shown in Fig 29 At the first cm level is the lower external orifice opposite the greater horn of the hyoid Between the 3½-5 cm level is seen irregularly attached cartilage At the 6½ cm level is seen the groove created by passage of the fistula around the facial nerve At the 7 cm level an annular ring of cartilage is seen which was adherent to the inferior aspect of the auricular cartilage At the 7½-8 cm level one can observe the external orifice of the upper end of the tract

lowing the tract into the pharynx.[15] The tract is ligated with fine silk or catgut at its entrance into the pharynx The external incisions are closed with fine interrupted silk sutures A long drain is placed through the lower incision and left in place several days. With this technique the scars are much less noticeable than when a long incision is made along the anterior border of the sternomastoid.

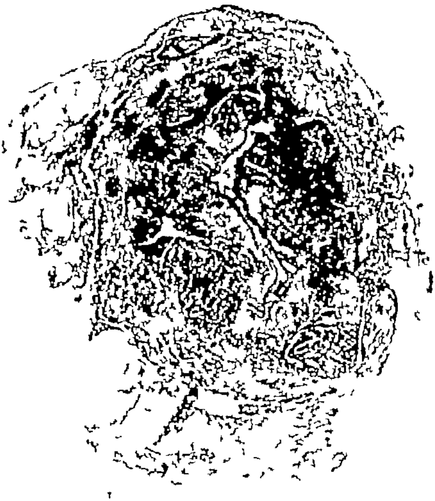

Fig 31 Photomicrograph of fistulous tract in Fig 9 Note lumen lined by stratified squamous epithelium Note the layer of lymphoid tissue and the external collagenous supporting structure

When removing a complete fistula tonsillectomy can be performed simultaneously,[23, 26] before[24] or afterward [19, 25]

An intimate knowledge of the embryology and anatomy of the neck is required for the surgical removal of cervical anomalies[19] These anomalous structures are closely related to vital structures Their dissection at times is tedious and intricate and requires patience and skill In the event of a second operation the skill required is even greater It must also be remembered that these anomalies need not always be extirpated if the cyst or fistula is symptomless there is no reason for operation, and the risk of later malignant degeneration is probably of no importance[30]

SUMMARY AND CONCLUSIONS

1 Lateral cervical cysts and fistulas are the result of disturbances in the early embryonic development of the neck These disturbances are due to the failure of complete absorption of included ectodermal and entodermal epithelium that is buried during the morphogenesis of the branchial arches.

2 The various embryonic sites where anomalies may develop are somewhat as follows

- *a.* The visceral or branchial pouches,
- *b* The branchial clefts or grooves,
- *c* The cervical sinus,
- *d* The epithelial placodes which are associated with the ganglia of the nerves of the arches,
- *e* Persistence of cervical vesicles II and IV (Garrett) (see Fig 7),
- *f* The pharyngobranchial duct III (third pharyngeal duct) (see Fig 8),
- *g* Canals of Kursteiner which arise when parathyroid III separates from the cervical thymus (see Figs 8, 9)

3 If pharyngeal pouches persist their internal openings would be as follows

- *a* Second pouch (dorsal or upper angle) orifice in lateral wall of nasopharynx (above the palato-pharyngeal arch)
- *b* Second pouch (lower or ventral angle) orifice in the

region of the supratonsillar fossa This is the most common type of pouch anomaly

c Third pouch orifice in the lateral pharyngeal wall or pyriform fossa above or anterior to the internal laryngeal nerve It may penetrate the thyrohyoid membrane

d Fourth pouch orifice in lateral pharyngeal wall or pyriform fossa below or behind the internal laryngeal nerve.

4 Cysts in the lateral pharyngeal wall may be the remnant of an internal pharyngeal duct, or may be derived from one of the epithelial bodies which are found in association with the pouches

5 Abnormal fusion between the walls of branchial clefts or grooves may give rise to branchial cysts and fistulas This is particularly common in the second cleft, which is probably the source of most of the usual branchial cysts Those cysts found in intimate relation with the tail of the parotid, rather than with the carotid sheath, are probably of first cleft origin The external openings of branchial grooves when they persist, are very variable in their position due to rapid growth of the ventral neck during the period in embryonic life when the branchial arches are developing When present they are along the anterior border of the sternomastoid muscle, particularly in the case of second cleft or cervical sinus anomaly Congenital auricular fistulas usually attributed to first cleft anomaly, actually arise from the developing skin of a specific intertubercular groove[48]

6 Failure of obliteration of the cervical sinus through fusion of its walls may be responsible for some branchial cysts, however, it must be kept in mind that in normal development no part of the cervical sinus as separate from grooves, forms a closed cyst like structure

7 The epithelial placodes which are associated with the ganglia of the nerves of the arches may persist as placodal cysts which draw away from the pharynx with continued growth, leaving long cell strands of ectoderm in contact with the pharyngeal pouches

8 The pharyngobranchial duct III (third pharyngeal duct) may fragment irregularly, leaving small isolated fragments which may later differentiate into accessory parathyroid or thymic rudiments, or may even be the site of origin of epithelial cysts

9 When parathyroid III separates from the cervical thymus small epithelial tubules arise which may persist (canals of Kursteiner) and give rise to cysts associated with parathyroid III and thymus III

10 The cervical sinus epithelium does not contribute to the formation of the thymus, which originates from the entoderm of the third pharyngeal duct

11 The embryonic thymic duct may give rise to persistent anomalies, but these are rare

12 The origin of any particular vestige can be deducted only after a careful anatomical examination with emphasis on relations followed after removal by microscopic examination These anatomical relations are most important in their pharyngeal aspects The second, third and fourth pouches and their corresponding external ducts bear definite and distinct relations to the main vascular and nervous structures

13 Every vestigial remnant in the lateral neck that has a deep connection as well as an outer opening passes up to cross the hypoglossal nerve before running to its original deep attachment.

14 The symptomatology, physical findings, differential diagnosis, pathology and treatment of branchial cysts and fistulas is reviewed

15 The surgical treatment of lateral cervical anomalies requires an intimate knowledge of the embryology and anatomy of the neck if one is to avoid damage to important structures and avoid the risks of recurrence.

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PRESBYCUSIS *

HAROLD F SCHUKNECHT, M D,

Detroit, Mich

In the cochlea, as in all the other organs of the body, th are senescent changes with the passage of time The classi manifestation of cochlear aging is high tone deafness cau by atrophic changes in the basal coil

The purpose of this report is to present the histologi findings in the cochlea of several animals and one human, of whom had such high tone hearing losses The findings particularly significant because there is a minimum of sup imposed postmortem autolytic change

THE AGING PHENOMENON

The high tone deafness of aging is the cochlear manife tion of a diffuse process which involves all the body tiss Within the fourth decade of life there already is decrea efficiency of some organs and of the individual as a wh In the fifth decade there usually is an apparent reduction efficiency, and the further passage of time brings a casc of senile changes which terminate in death during the seve or eighth decades of life Many investigations have been p formed in an attempt to provide information on the mech ism of the aging process It is known that with increas age there is decreased ability of certain cell systems to dergo mitosis [1,2] decrease in nucleoprotein in certain syster accumulation of insoluble compounds in the cytoplasm,[4] chemical changes occur in the intercellular fluid [5] A gr many morphological, chemical and physiological changes h been demonstrated in the individual cells of the various b *systems* [6]

It is now clearly understood that aging cannot be accour for on the basis of changes in one particular system, *e g*,

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*Read as Candidate s Thesis at the Fifty-ninth Annual Meeting of American Laryngological Rhinological and Otological Society Inc Ho wood Fla March 1955

Editor s Note This ms received in The Laryngoscope Office and acce for publication February 10 1955

cardiovascular system in man Although popular cliché has it that a man is as old as his arteries, there is not a satisfactory parallelism between vascular change and senility Too many symptoms of old age are apparently independent of blood vessel alteration to establish this single entity as a cause of senility The study of aging changes in individual cells is complicated by the fact that the cellular population changes during the life of the body and also that there is difficulty in distinguishing the normal changes of aging from alteration caused by injury or disease

Cowdry[4] has helped to clarify this complex problem by classifying the cells of the body into four groups, depending upon the character of their lives *Group 1,* termed "vegetative intermitotics," includes those cells whose main function is reproductive, such as the red bone marrow, the basal cells of the epidermis and the spermatogonia of the testicles *Group 2,* "differentiating intermitotics," consists of a group exhibiting increasing specialization, such as the lineage of cells which lead to leukocytes and spermatozoa *Group 3* is designated as "reverting postmitotics" because, though they generally age and die, some of them are capable of reversion Liver cells for example, can multiply in the event of the removal or death of large numbers of their fellows *Group 4* is called the "fixed postmitotics" and constitutes the highest plane of differentiation After specialized function has been established for them there is no turning back they age and die. Among this group are cardiac and skeletal muscle cells, odontoblasts, bone cells rod and cone cells, cells of the organ of Corti, nerve cells including the spiral ganglion, and dozens of other cell types The deafness of aging is caused by degenerative changes occurring in fixed postmitotic cells For them the length of individual cell life is not conditioned by stimulation or inhibition of mitotic activity but by ability to maintain their characteristic structural organization in the continual adaptation they must make to changes of the tissue fluid environment. The length of individual life for many postmitotic cell types seems to be determined in some measure by heredity It is known that certain families display hereditary patterns of premature cellular decay in certain cell systems, *e.g.*, high tone deafness is known to develop earlier in some families than in others.

EXISTING CONCEPTS REGARDING PRESBYCUSIS

Since Zwaardemaker in 1899[7] first described the clinical manifestations of high tone deafness with aging there have been a number of reports on the pathology of this condition. Some of the changes described undoubtedly were due to postmortem autolysis of the membranous labyrinth.

An outstanding contribution to our knowledge of the pathology of high tone deafness was made by Crowe, Guild and Polvogt in 1934.[8] This study was a correlation of the clinical and pathological findings in 79 human ears, the audiograms of which showed impairment of hearing limited to the high tones. Although there were many exceptions, they were able to classify their cases into two general groups: one with abrupt high tone hearing losses in which the most prominent lesion was an area of atrophy of the organ of Corti at the basal turn, and a second with gradual high tone loss in which the most prominent lesion was partial atrophy of the cochlear nerve supply in the basal turn. In some cases they were unable to explain the hearing losses on the basis of cochlear pathology. They found no parallelism between arteriosclerotic changes in the vessels of the ear and degeneration of the membranous labyrinth and nerve, and discounted arteriosclerosis as a cause of the changes.

Saxen[9] presented another important paper in 1937 on the pathological changes in human cochleae as the result of aging. He found two types of degenerative change: *1.* Atrophy of the spiral ganglion, beginning in the basal coil, and regarded by him as process of wear and tear typical of old age; *2.* Angiosclerotic degeneration of the inner ear, characterized by degenerative change of the epithelial tissues of the membranous cochlear labyrinth and considered by him to be due to arteriosclerosis. He also had an elderly patient with marked hearing loss and no labyrinthine or cochlear nerve changes and believed, therefore, that deafness could result from changes in the central nervous system.

Guild and Saxen both recognized two types of presbycusis the pathology in one involving mainly the organ of Corti, in the other, the spiral ganglion They also believed that there were some cases in which there was inadequate cochlear pathology to explain the deafness The relationship of these two types of presbycusis to each other and to aging processes elsewhere in the body has not been clarified

METHOD

In a number of experiments during the past few years my associates and I have examined the cochleae of 72 cats, on which we performed tests of auditory threshold Behavioral tests were performed on 27 cortical tests on 32, and both cortical and behavioral tests on 13 Three of these 72 animals (4 per cent) had objectively demonstrable hearing losses prior to experimentation and on histological examination were found to have degenerative lesions in the basal coil For the remaining 69 ears the thresholds were normal for the frequency range 125 to 16,000 cps If we subtract from this group the 22 ears with experimental pathological lesions in the basal coil and 21 ears from very young animals there remain 26 cochleae from full grown cats without an experimental lesion in the basal coil and with normal thresholds *up to 16 000 cps Five, or 20 per cent of these cochleae had* degenerative changes in the basal coil ranging from one-half mm to two and one-half mm in size These lesions, obviously, were too far basalward to register as a hearing loss on our tests

An additional ear exhibiting a high tone threshold loss on cortical testing was provided by Dr Joseph Hind

For all animals the function of one ear was destroyed by a surgical operation The behavioral hearing tests were performed by training animals to respond to pure tone auditory stimuli by moving forward in a rotating cage to avoid shock When the response was learned the stimulus intensity was reduced to determine auditory thresholds The cortical test was performed by exposing the contralateral auditory cortex and displaying the potential difference between an electrode on the cortex and an electrode on the neck on a cathode ray oscilloscope A determination was made of the minimum sound pressure required at each frequency to elicit strychnine spikes to a tone pulse delivered to the ear through a piece of plastic tubing Both the behavioral and cortical methods are described in detail elsewhere[10,11]

The animals were sacrificed by intravital perfusion with 10 per cent formalin solution Postmortem autolysis was arrested in the human ear by injecting 20 per cent formalin into the middle ear soon after death The temporal bones were decalcified, imbedded in celloidin and serially sectioned Graphic reconstructions of the cochleae were made and the pathological findings entered on tables Quantitative estimates of degree of pathological change were made for 11 structures at approximately 125 points in each cochlea

The threshold curves and the pathological findings in the cochleae have been graphically displayed on charts The frequency scale of each audiogram and the distance scale of the cochlear chart were plotted on parallel and equal length coordinates The frequencies were arranged according to the anatomical frequency scale which takes into consideration their spatial distribution along the cochlear duct The evidence supporting this scale for the cat is presented elsewhere.[10] The black filling in the cochlear charts indicates the estimated percentage of degenerative change for the various structures

PRESBYCUSIS DUE TO EPITHELIAL ATROPHY

The pathological findings in four cat ears are representative of the first type of presbycusis which is characterized by atrophic changes in the membranous labyrinth (see Figs 1 and 2)

Cat 1 This animal was sacrificed by intravital perfusion with 10 per cent formalin after having been used for another, unrelated, experiment. The behavioral thresholds were within the range of average normal for the frequencies tested from 125 to 16,000 cps The pathological findings in the cochlea are representative of those changes occurring in a series of five animals having no demonstrable threshold changes but having small lesions at the basal end of the cochlea

There was atrophy of the organ of Corti in the first 2 5 mm with total loss of hair cells and partial loss of spiral ganglion cells in this region Lesser degrees of atrophy existed in the pillars to the 3 8 mm. region and in Hensen's and sulcus cells to 4 5 mm The tectorial membrane was markedly distorted in the first 2 5 mm The stria vascularis limbus spiral ligament and Reissner s membrane were normal throughout There were no detectable changes in the vessels of the stria vascularis spiral ligament or modiolus The efferent nerve bundle appeared normal No attempt was made in this study to evaluate the condition

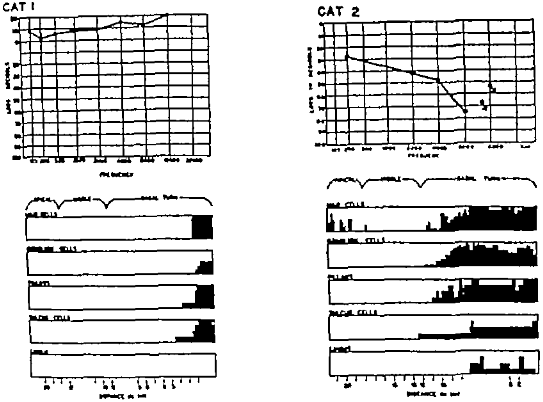

Fig. 1. Behavioral audiograms and cochlear charts for two cats with epithelial atrophy of basal end of cochlea.

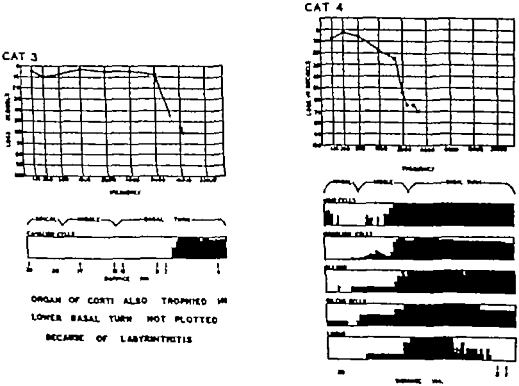

Fig. 2. Behavioral audiograms and cochlear charts for two cats with epithelial atrophy of basal end of cochlea.

of the efferent nerve fibres in the basal 4 mm of any of the cochleae studied The vestibular membranous labyrinth, including the sense organs and vestibular nerves were normal

Cat 2 The behavioral audiogram on this animal revealed a gradual type of high tone threshold loss The animal was given a general anesthetic and an otoscopic examination was performed to rule out the possibility of impacted cerumen as a cause for the hearing loss The animal was sacrificed by intravital perfusion with 10 per cent formalin The middle ear, auditory bulla and ear drum appeared normal Histological examination showed a close parallelism in the severity of atrophic change occurring in hair cells ganglion cells and pillar cells The change in sulcus cells and Hensen's cells extended 1 mm further than other detectable changes in the membranous labyrinth Decreased cellularity was noted in the limbus from 5 mm to 7 mm and in the spiral ligament from 0 to 8 mm There was localized atrophy of the stria in the 2 to 4 mm region The tectorial membrane and Reissner s membrane appeared normal throughout There were no detectable changes in the blood vessels of the spiral ligament stria vascularis or modiolus The efferent nerve bundles to the basal turn (Bundle "B' and 'C' of Rasmussen[1]) were severely degenerated whereas the efferent bundle to the middle and apical turns (Bundle "A" of Rasmussen) appeared normal. The vestibular membranous labyrinth, including sense organs and vestibular nerves, appeared normal throughout

Cat 3 Behavioral audiograms revealed normal auditory thresholds to 8 000 cps with progressively increasing threshold losses for the frequencies 10,000 12,000 and 14,000 cps No response was made to frequencies above 14 000 cps at the maximum intensities available The animal was anesthetized and an otoscopic examination performed to rule out the possibility of impacted cerumen as a cause for this hearing loss The tympanic membrane appeared normal and there was no wax in the ear canal Later an operation was performed on the apex of the cochlea The animal died 24 hours postoperatively and was perfused immediately after death with 10 per cent formalin solution As a result of the surgical procedure performed on the apex there was an acute destructive lesion involving the organ of Corti in the region from 16 mm to the apex In the basal coil from 0 to 6 5 mm there was total atrophy of the organ of Corti and almost complete loss of spiral ganglion cells There was decreased cellularity of the spiral ligament from 0 to 6 5 mm. region and the limbus from 3 5 to 6 5 mm The stria vascularis was atrophic in the region from 2 to 4 mm In the intermediate region from 6 5 mm to 16 mm there were changes in the organ of Corti consistent with a mild postoperative labyrinthitis so that the organ of Corti was not satisfactory for detailed morphological study The efferent nerve bundle was partially degenerated in the lower basal turn but normal elsewhere The vestibular membranous labyrinth, the sense organs and the vestibular nerves were normal throughout There were no pathological changes in the blood vessels of the spiral ligament, stria vascularis or modiolus

Cat 4 Cortical tests on this animal showed a threshold elevation for frequencies above 500 cps with a complete loss of response above 2 000 cps Immediately after cortical testing the animal was sacrificed by intravital perfusion with Heidenhain Susa solution Histological examination showed advanced atrophic changes in all structures of the organ of Corti and almost complete loss of spiral ganglion cells to the 14 mm region (see Fig 3) There were less severe changes in the region from 14 to 18 mm Decreased cellularity of the limbus extended from 3 to 17 mm with a total loss of nuclei between 7 and 12 mm The tectorial membrane was completely missing at the basal end, making its appear ance at 2 mm. and becoming normal at 5 mm The spiral ligament appeared normal except for decreased cellularity in the region from 8 5 to 9.3 mm., and the stria vascularis was moderately atrophic in exactly the same region. Reissner's membrane was intact. The blood vessels of the

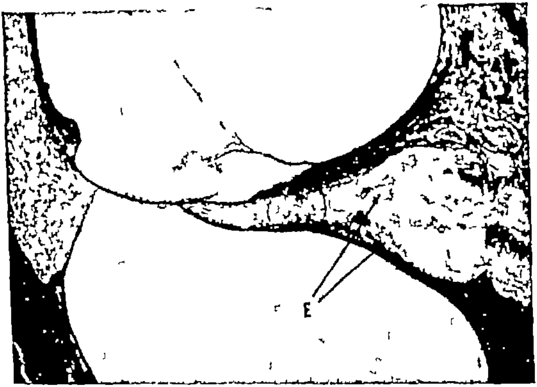

Fig 3 Photomicrographs of the 11 mm region of Cat 4 The organ of Corti is missing totally The nuclei of the limbus are missing except for a few which remain near the vestibular lip The spiral ganglion cells are missing except for four shrunken cells. The efferent nerve bundles ("E") have degenerated.

spiral ligament stria vascularis ganglion canal and modiolus appeared normal throughout. Many of the spiral ganglion cells which remained in the basal and middle turns were somewhat shrunken and had condensed nuclei. When compared with the normal appearing vestibular ganglion the contrast was distinct. The fibres of the efferent nerve bundles were degenerated up to the 17 mm region beyond which they appeared normal. The vestibular membranous labyrinth, including sense organs and vestibular nerves appeared normal throughout.

* * *

The pathology in each of the four animals was much alike, the principal features were atrophic degenerative changes in the membranous cochlear labyrinth, including afferent and efferent nerve fibres, which began at the basal end and proceeded toward the apex (see Fig 4)

The changes parallel closely the pathology described by Crowe, et al, for human ears with abrupt high tone deafness

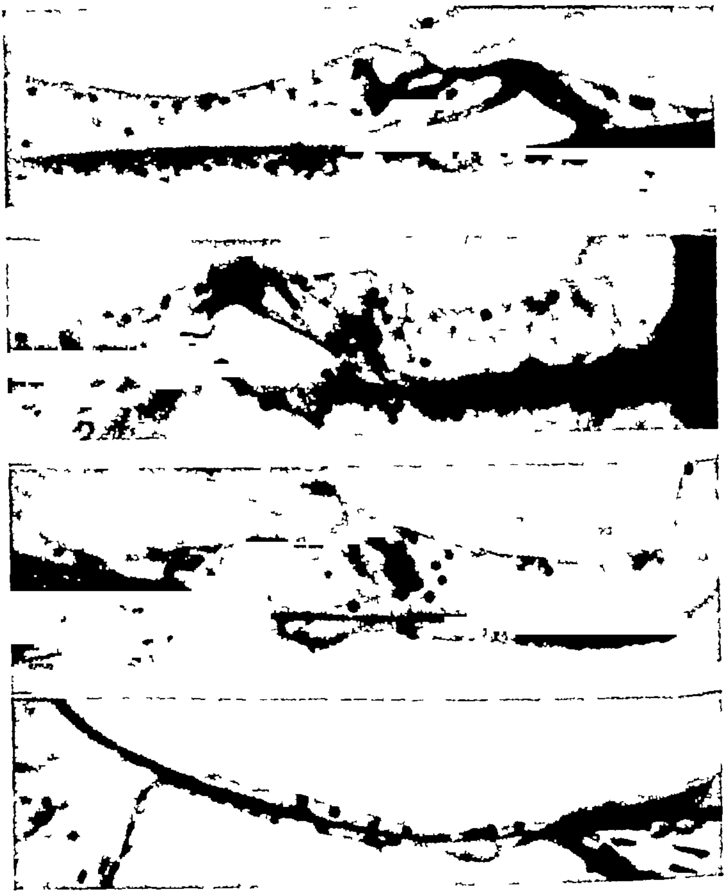

Fig 4 Progressive stages of degeneration of the organ of Corti in the epithelial atrophy of presbycusis

1 From the 18 mm region of Cat 2 The hair cells and pillars are normal The slight swelling of the external sulcus cells and slight flattening of Hensen's cells may be fixation artifact. The spiral ganglion was normal in this region

2 From the 11 mm region of Cat 2 A few outer hair cells are missing in this region The inner pillar is crooked The outer sulcus cells are swollen and Hensen's cells are slightly flattened. There was a loss of 10 per cent of the spiral ganglion cells

3 From the 8 mm region of Cat 2 The hair cells are missing There is a total loss of pillars except for a remnant of the inner pillar The sulcus cells and Hensen's cells are further degenerated In this region 85 per cent of the spiral ganglion cells are missing

4 From the 11 mm region of Cat 4 The organ of Corti is missing entirely except for a few epithelial cells which lie on the basilar membrane About 95 per cent of the spiral ganglion cells are missing in this region of the cochlea.

and is identical to that which I have seen in human ears in Dr John Lindsay's collection at the University of Chicago

The question arises whether the change originates in one of the structures with other elements suffering because of changes in the first In this regard, it is known that the degenerative change could not be primary in either the hair cells or spiral ganglion, because either of these structures can be lost independently without imposing a degenerative change upon the other or upon the supporting elements

The change could not be primary in the supporting elements, as I once proposed, because although this would explain the loss of hair cells and ganglion cells it would not explain degeneration of the efferent nerve bundle For example, in severe stimulation injury the efferent nerve bundle is known to persist even though the organ of Corti and its afferent nerve supply are completely lost

It is also not likely that the atrophic changes in the membranous labyrinth and spiral ganglion are secondary to degeneration of the olivo-cochlear bundle in view of Rasmussen's experiments in which the bundle was cut without creating an atrophic change in the organ of Corti during a period of several weeks

After a consideration of all the evidence it seems reasonable to assume that the degenerative change as it proceeds up the cochlear duct affects almost equally and simultaneously the various structures within it, including the afferent and efferent nerve fibres. The reason why the atrophic change selects the basal end is as great a mystery to me as the process of aging itself

These cochlear changes probably are a manifestation of the same degenerative process affecting supporting tissues elsewhere in the body The presbycusis curves for men and women show that it begins in middle age (see Fig 5) A close corollary is to be found in the skin, another ectodermal structure As early as the third decade of life the epidermis begins to lose its rete-peg pattern and becomes thinner Beginning in the fourth decade there are changes in the dermis consisting of clumping and basophilic staining of collagen fibres and hyalin degeneration and fragmentation of elastic fibres These changes are responsible for the wrinkling and flaccidity of the skin of the aged

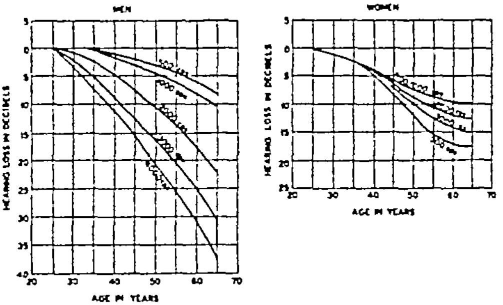

Fig 5 Presbycusis curves for men and women from The Relations of Hearing Loss to Noise Exposure Am Standard Assn 70 E 45th St., N Y These curves were plotted from data obtained in large population surveys by Bunch Steinberg et al and Webster et al In each of these studies the reference line (zero hearing loss) was the average hearing loss in the group between 20 and 29 years of age

The pathological changes occurring in stimulation deafness[13 14] which differentiate it from epithelial atrophy are *1* The most severe injury is located some distance from the basal end of the cochlea (10 mm in the cat) whereas in epithelial atrophy the changes are most advanced at the basal end, *2* Loss of hair cells is always greater than loss of spiral ganglion cells, whereas in epithelial atrophy the loss of hair cells and spiral ganglion cells are closely parallel, *3* The efferent nerve fibre bundles do not degenerate

The pathological changes in non-suppurative labyrinthitis which differentiate it from epithelial atrophy are *1* It is more diffuse, usually involving the entire cochlea, *2* Hair cell loss is greater than ganglion cell loss, *3* There is histological evidence of inflammatory reaction, such as envelopment of tectorial membrane by epithelial cells

In certain types of congenital deafness, such as that due to rubella, there are pathological changes in the saccule, as well as the cochlea, a situation which never exists in epithelial atrophy

Structure	Magnitude of Injury
Hair Cells	Each hair cell rated as either normal slight morphological change severe morphological change or missing.
Spiral Ganglion	Estimated percentage of ganglion cells missing 0 to 100 per cent in 5 per cent steps
Reissner s Membrane	Recorded as intact or torn
Tectorial Membrane	Displacement not rated as abnormal Structural abnormality rated from 0 to 100 per cent in 25 per cent steps
Spiral Ligament Limbus	Each rated according to per cent of nuclei missing within structure from 0 to 100 per cent in 25 per cent steps
Pillars Hensen s Cells Sulcus Cells	Each rated according to architectural appearance and number of cells remaining from 0 to 100 per cent in 25 per cent steps
Stria Vascularis	Estimate of percentage atrophy 0 to 100 per cent in 25 per cent steps
Efferent Nerve Fibres	Estimate of percentage of fibres remaining 0 to 100 per cent in 25 per cent steps

PRESBYCUSIS DUE TO NEURAL ATROPHY

The second type of presbycusis I have termed neural atrophy because I believe it is due to a decrease in population of the neurons of the auditory nervous pathways Ordinarily its onset is in older age, and is superimposed upon the epithelial atrophy already described The pathological features are shown in the following case.

Mr S U of Chicago This 70-year-old carpenter developed carcinoma of the floor of the mouth with insurmountable cervical lymphatic metastases When it became obvious that the ulcerating metastatic lesion was invading the common carotid artery the patient was admitted to the hospital for terminal care After admission to the hospital an audiogram was partially accomplished for the right ear four frequencies having been tested in consecutive order from 8 000 cps to 1,000 cps when sudden profuse bleeding from the neck occurred and the audiometric examination had to be discontinued (see Fig 6) The patient was mentally alert and comfortable during the test, and the results were considered to be reliable by the audiologist * The patient died five hours later Thirty minutes after death the right ear drum was removed partially the stapes was dislocated and the middle ear was filled with 20 per cent formalin solution The left ear was not injected because it was used as a control to determine the effectiveness of the injection method The postmortem changes in this ear were severe so that it was not used in the present study Three hours and 50 minutes after death the temporal bones were removed and placed in Helly s solution

Histological examination revealed typical epithelial atrophy to the 8 3 mm point. There were characteristic atrophic

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* I am indebted to Mr Duncan R. C. Scott for performing the audiogram

changes in the pillars, stria vascularis, tectorial membrane, hair cells and ganglion cells to the 3 3 mm region Slight degenerative changes in the sulcus cells and Henson's cells extended to 3 6 mm Reissner's membrane was torn in the region between 1 and 2 3 mm No changes were seen in the blood vessels of the stria vascularis, spiral ligament or modiolus

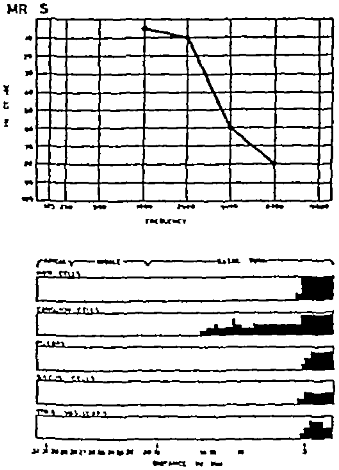

Fig 6 Audiogram and cochlear chart of a 70-year-old man with high tone deafness There is epithelial atrophy for 3½ mm and a superimposed neural atrophy extending to 14 2 mm

In addition there was 30 to 50 per cent loss of spiral ganglion cells extending from 3 3 to 14 2 mm without accompanying change in the organ of Corti or other structures of the membranous labyrinth It is more difficult to judge the percentage of ganglion cells missing in human than in animal ears, because the ganglion canal in the basal coil normally is not filled with neurons Judgments for this ear were made by comparison with the ganglion cell density existing in normal ears of young persons The efferent nerve bundle appeared normal throughout The vestibular membranous labyrinth, including the sense organs and vestibular nerves, appeared normal The ganglion cells which remained in the basal coil appeared normal

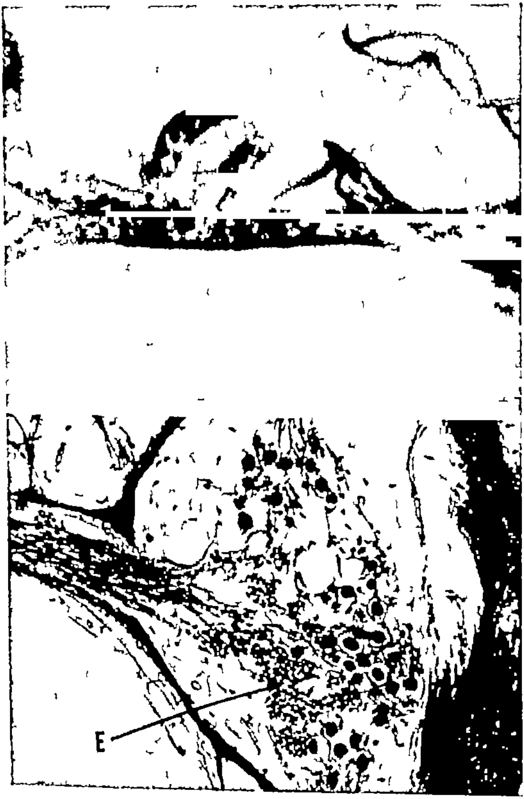

Fig 7 Photomicrographs from the ear of Mr S Above Normal organ of Corti from the 11 5 mm region. Below Spiral ganglion from the same region with an estimated loss of 30 per cent of the cells.

In the audiogram the frequencies have been arranged on a theoretical anatomical frequency scale A similar scale was suggested by Koenig[15] and has been used for guinea pigs by Davis[16] For the guinea pig frequencies above 1,000 cps were arranged logarithmically, and those below 1,000 cps arithmetically, so that each 100 cycle interval was equal to the distance between 900 and 1,000 cps on the logarithmic scale For the human, I have selected 31 25 cps as the lowest frequency of the audiogram and 20,000 cps as the highest, both extremes are an octave lower than that used for the cat Justification for the low frequency limit is based on Bekesy's[1] observations that the lowest frequency still having a point of maximum displacement on the cochlear partition is about 25-35 cps It is known that the high tone limit for young persons extends to 20,000 cps The frequency of 500 cps was selected arbitrarily as a dividing point between the logarithmic and arithmetic scales

For human ears, Crowe, et al, correlated hearing loss with location of nerve fibre lesions and thus related the 4,096 frequency to the 7-8 mm region, and the 8,192 frequency with the 4-5 mm region[8] It should be pointed out, however, that correlations of this kind are complicated by the fact that there is not a close parallelism between nerve fibre population and pure tone threshold[18]

A corollary to atrophy of the spiral ganglion exists in the brain, for it is well established that the aging brain suffers from a loss of nerve cells The process develops independently of cerebral arteriosclerosis, but may co-exist with varying degrees of it The clinical manifestations of loss of cortical neurons is senile dementia, characterized by a gradual diminution of physical and mental capacity, an exaggeration of prior personality traits, increasing intellectual failure, impairment of memory, errors of judgment and insomnia The cell outlines of the cortical neurons become shrunken and irregular, the cytoplasm becomes hyperchromatic, the Nissl material decreases, the nuclei become basophilic and later there is glial proliferation and neuronophagia Whereas senile dementia is a clinical manifestation of loss of cortical neurons, a loss of discrimination ability and auditory acuity are expressions of loss of neurons in the auditory pathways

Neuron loss in the higher auditory centers also would be expected to create discrimination loss, and if severe enough, threshold losses, too It may be that the threshold losses which Guild and Saxon could not explain on the basis of pathology in the cochlea or spiral ganglion were due to neural degeneration at higher levels

It is an established clinical observation that the deafness of aged patients is characterized by decreased auditory discrimination in the presence of disproportionately small loss in pure tone thresholds This has been termed "phonemic regression" Experimental and clinical evidence has established that these relationships are characteristic of neural degeneration For example, it has been shown experimentally that 75 percent of ganglion cells may be lost to certain regions of the cochlea without creating threshold elevations for frequencies having their fields of excitation in those regions, whereas greater ganglion cell losses do create threshold losses, furthermore audiological studies on human patients with acoustic neurinomas have shown that decreased speech discrimination may exist with disproportionately small pure tone threshold losses[18] The implication of this finding is that only a few nerve fibres are needed to carry impulses of threshold magnitude. I do not believe, therefore, that the spiral ganglion cell deficit in the 3 3 to 14.2 mm regions can alone account for the threshold losses for the frequencies 4000 to 8000 cps The most reasonable explanation, it seems to me, is that there are also deficits in the population of 2nd, 3rd and 4th order neurons and that the composite loss of neurons is sufficient to affect thresholds

Along with other considerations it is important to establish the discrimination ability of the presbycusic patient when considering the usefulness of a hearing aid The folly of amplifying markedly distorted patterns of auditory neural activity is well known From the diagnostic standpoint it can be said that the neural atrophy type of presbycusis exists when the loss of discrimination ability is more severe than would be expected from limitation of high tone hearing alone.

The pathological anatomy existing in both the epithelial and neural types of presbycusis does not produce recruitment It is known that recruitment requires an incomplete sensory lesion, in other words, there must be a partial loss of hair cells with normal or near normal numbers of ganglion cells remaining within the fields of excitation[19] Thus, at high intensities the hair cells which remain are capable of exciting normal numbers of nerve fibers This type of cochlear change commonly exists in toxic, inflammatory and traumatic lesions of the organ of Corti, therefore, the recruitment test can sometimes be of value in the differential diagnosis of high tone deafness in that its presence rules out presbycusis

CONCLUSIONS

A quantitative study was made of the pathological anatomy in the ears of several cats and humans with high tone deafness The evidence indicates that there are two types of presbycusis The first, termed "epithelial atrophy," is characterized by degenerative changes which begin at the basal end of the cochlear duct and proceed toward the apex, affecting almost equally and simultaneously the various structures within it, including the afferent and efferent nerve fibres The process begins in middle age, progresses very slowly for decades, and manifests itself clinically by the familiar presbycusis curves It is the otological manifestation of an aging process which affects all tissues, a close corollary existing in the skin where the changes are so characteristic they are used as a yardstick to measure the age of the individual

The second type, termed "neural atrophy," is characterized by degeneration of spiral ganglion cells beginning at the basal end of the cochlea as well as neurons of the higher auditory pathways and is superimposed upon varying degrees of epithelial atrophy Its onset is late in life, it progresses slowly for years, and is characterized clinically by high tone deafness with disproportionately severe loss in auditory discrimination It is the otological manifestation of an aging process affecting the central nervous system which is characterized by a loss of neuron population and has a corollary in the cerebral cortex where loss of neurons results in senile dementia

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TRANS-SPHENOIDAL APPROACH TO THE PITUITARY GLAND*

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The high mortality and technical difficulties of frontal craniotomy for the removal of pituitary tumors directed the surgeons (not the otolaryngologists) to the trans-sphenoidal approach to these lesions This technique was first suggested by Schloffer[1] in 1906 and performed by him in 1907[2] He employed a lateral incision for the dislocation of the external nose and popularized the procedure for the first decade of interest in this field

It is reported that more than 100 operations of this type were performed by various surgeons during this early period Von Eiselberg[3] used this method in performing the first operation for Frolich's syndrome in 1907, and Hochenegg[4] performed the first operation for acromegalia in 1908 Different methods of dislocating the external nose in an effort to reach the sphenoidal sinus were attempted by a number of surgeons Dislocation from above downward was used by Proust[5] in 1908, from below upward by Kanavel in 1910,[6] and again by Kanavel and Grinker in the same year (1910)[7]

A sublabial incision was devised by Halstead in 1910[8] Hirsch,[9] in 1909, suggested the trans-sphenoidal endonasal operation with local anesthesia and performed it successfully in 1910 This procedure was first made possible by opening one sphenoidal cavity through the ethmoidal route by Hajek[10] From observations derived from this method, Hirsch developed the septal approach to both sphenoidal sinuses by performing

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a submucous resection of the nasal septum[11] Cushing subsequently combined the sublabial incision of Halstead with the septal method of Hirsch in 1912.[12] An interest in this surgical procedure became manifest among rhinologists of this period, and various surgical approaches were devised and recommended for operations upon the pituitary gland The paranasal method of Chiari in 1912[13] using the external ethmoidectomy was employed The gingivo-labial incision and trans-maxillary sinus route of Fein[14] and Denker[15] and the palatine methods of Preysing[16] and Tiefenthal[17] enjoyed a brief period of popularity It soon became obvious, however, that none of these methods offered the advantages of the septal procedure, especially in regard to postoperative management and secondary operations for recurrences.

It would seem that almost everything that could be written about chromophobe pituitary adenomas has been published, but recent endocrine studies furnish fresh information which necessarily alters some of our concepts in respect to diagnosis and treatment There can be little question that this new knowledge gives us a better understanding of the effects of these lesions upon the general economy of the patient, and points the way to improved management and a more hopeful prognosis.

Basic studies of pituitary gland secretion have established the fact that when the anterior lobe of a normal gland has been removed, there is an abrupt interruption in the production of four important hormones with a simultaneous loss of the stimulating effects which each one has upon specific "target organs"

1 *The somatotropic or growth hormone,* whose target organ is protein tissue (muscle, bone, etc.) When lost, the individual's growth is interrupted stature remains small, and his appearance is that of a younger individual than his chronological age X-rays of the skeletal framework may demonstrate delayed bone growth.

2 *Loss of the gonadotropic hormone,* the follicle stimulating hormone, results in subnormal function of the ovaries

in the female and the testes in the male In the former, one will note a delayed appearance or disappearance of the secondary sexual characteristics and an amenorrhea The skin is smooth and there is an absence or decrease of pubic and axillary hair Breast development is decreased or absent In the male, one likewise observes the smooth "baby" skin and scant or absent pubic and axillary hair The penis, scrotum and testicles are under-developed and there is a delayed appearance or decrease of facial beard

3 The thyrotropic hormone stimulates the thyroid gland Its loss is characterized by decreased sweating, ease of fatigue, loss of stamina, and somnolence One will note a dry to cool skin, bradycardia, loss of body hair, and slow responses

4 The last important hormone, *adrenocorticotropic hormone* (ACTH) stimulates the adrenal cortex Its absence is characterized by a hypoglycemia, postural hypotension, and decreased strength and stamina One may also note a pale, smooth skin (alabaster skin), decreased axillary hair and decreased skin pigmentation With the loss of the four essential hormones of the pituitary gland, certain important urinary findings are noted

The growth of a chromophobe tumor is usually slow and obviously not attended by an abrupt interruption of anterior lobe secretions Thus we may observe a variety of target organ deficiencies with emphasis upon one or two of them, or a combination of all four It is of clinical significance that target organ deficiency usually appears in a selective sequence and in accordance with nature's design The tropic hormones, least important to life, are the first to be lost, while the most vital for survival, are the last to disappear Thus we observe that growth and gonadotropic hormones are the first to be depleted, while thyrotropic and adrenotropic hormones are the final ones which fail to function It is, of course, obvious that one cannot determine the presence or absence of the growth hormone in the adult nor can one observe clinically the status of the gonadotropic sphere in the period preceding puberty

CLINICAL OBSERVATIONS

The chief complaints of the patients with chromophobe adenoma of the pituitary, who have come to our attention, have been blurred vision and headaches. As the lesion encroaches upon the visual pathways, one usually finds a right or a left homononymous hemianopsia due to pressure upon one of the optic tracts. There may be only a slight temporal defect of the visual field on one side or the other. The classical bitemporal hemianopsia was observed in four of twelve cases of chromophobe adenoma recently studied by us. Quoting from our textbooks it is observed that this typical visual finding occurs in only 50 per cent of the cases. At the first examination we frequently find that the patient is so blind that the type of hemianopsia which previously existed cannot be discovered.

Associated with a blurring of vision, one may observe a partial or complete paralysis of the external ocular muscles, chiefly those supplied by the third cranial nerve.[11] I should like to emphasize that a pale disc does not necessarily indicate an alarming degree of optic atrophy. In several of our patients the pallor was extreme, but an amazing amount of visual acuity returned when pressure was removed from the visual pathways by surgical interference. Walker and Cushing,[12] observed in histological examinations of optic nerves of this character, that the amount of fibers preserved was often substantially more than expected. One is frequently gratified to observe a remarkable improvement in vision after surgical procedures for chromophobe adenomas in patients who have been doomed to an optic atrophy of an irreversible character.

Headache may be the first symptom of which the patient complains. It may be excruciatingly severe. At first it is usually bi temporal but later tends to become more or less a general type. An early symptom in the male is loss of libido and in the female a diminution or cessation of menstruation. Body hairs become scant and some degree of obesity is often in evidence. A subnormal basal metabolic rate is a frequent finding. The signs and symptoms change in different patients from time to time depending upon the size of the lesion, its proportions in relation to neighboring structures, and its pathological behavior The roentgenographic examination is the most important method of determining the size and anatomical relationships of the pituitary adenoma In the Roentgenogram, one may note merely an enlargement of the sella or a deformity of its floor, and finally perhaps complete destruction of the sella turcica

Cerebral angiography is one of the most important means of demonstrating the intracranial extension of the lesion and displacement of the internal carotid arteries It is highly essential to visualize the carotid system in this manner before surgical intervention is instituted The relationship of the internal carotid arteries to the lesion is an observation that must be made in the interest of the patient's safety before the trans-sphenoidal approach to the adenoma is attempted

It is often possible to speculate with some degree of accuracy upon the nature of the lesion by evaluating its clinical behavior For example, rapid growth, as determined by the rapidity of symptoms and extensive destruction of the base of the skull observed in the Roentgenogram, suggests the presence of an adeno-carcinoma Dramatic clinical symptoms such as sudden blindness, extra-ocular palsies, coma, signs of intracranial and subarytenoid hemorrhage, and acute pan-hypopituitarism have an important clinical significance in determining when and how the patient should be treated As a rule, signs and symptoms of this character call for an emergency surgical attack upon the lesion if the patient's vision or perhaps his life is to be saved Here again, angiography may be most useful in differentiating an adenoma of the pituitary gland from a bleeding intracranial aneurism

MANAGEMENT

Because the incidence of pituitary adenomas is relatively low the number seen in any one institution is usually not great It is encumbent upon us, therefore, to accumulate and evaluate the experiences of other qualified workers in this field and to draw heavily from the concepts and philosophy of treatment of such outstanding contributors as H Dubney Kerr,[20] Franz Buschke,[21] L M Davidoff,[22] C C Dyke,[23] J E Paterson,[24] M C Sosman,[25] and others

TABLE I. CLINICAL MANIFESTATIONS OF TARGET ORGAN DEFICIENCY

Trophic Hormone	Target Organ	Symptom	Sign	Laboratory Data
Somatotrophic (STH) or Growth (GH)	Protein tissue (muscle, bone, etc.)	"Stopped growing'	Short stature Appears younger than chronological age	X rays of wrists show delayed bone growth
Gonadotrophic (Follicle Stimulating Hormone—FSH—only one which can be assayed)	Ovaries	Delayed appearance or disappearance of secondary sexual characteristics. Amenorrhea	Smooth "baby' skin Absence or decrease of pubic and axillary hair Absence or decrease of breast development	Low urinary excretion of Follicle stimulating hormone (FSH) Estrogens 17 ketosteroids
	Testes		Smooth 'baby' skin Absence or decrease of pubic axillary and scrotal development Absence or decrease of penile testicular and scrotal development Delayed appearance or decrease of facial beard	Low urinary excretion of 17 ketosteroids
Thyrotrophic (TSH)	Thyroid	Cold intolerance Decreased sweating Ease of fatigue Loss of stamina Somnolence	Dry cool skin Bradycardia Coarse hair Loss of body hair Slow responses	Low BMR High (or normal) cholesterol Low protein bound iodine (PHI) Low I_{131} uptake
Adrenocorticotrophic (ACTH)	Adrenal Cortex	Pre-breakfast hypoglycemia (weakness, headache relieved by food)	Pale, smooth skin ('alabaster skin) Decreased axillary hair	Low FBS Low Na and Cl (occasionally)
		Postural hypotension (faintness on standing)	Postural hypotension (fall in systolic and diastolic BP on standing)	Low 17 hydroxysteroids (17 OH) Low 17-ketosteroids (17-KS)
		Decreased strength and stamina Decreased skin pigmentation Loss of axillary and pubic hair		

If the diagnosis can be established clinically at an early date and with a fair degree of accuracy, it is our opinion that irradiation should be used as the primary treatment. This is accomplished by a single course technique which consists of delivering a tumor dose of about 3000 r in three weeks through two lateral fields It has been definitely shown that this order of dosage is sufficient to arrest permanently the growth of such a lesion in some patients Our Roentgenologist reports that this technique will give satisfactory results in 60 to 70 per cent of his cases, however, the patients coming to my attention are those who have not responded satisfactorily to X-ray therapy They come to me with the signs and symptoms of advanced growth which frequently calls for emergency surgical measures The indications for operation may be listed as follows

1 The imminent possibility of blindness or rapidly decreasing visual fields

2 Severe intractable headache not relieved by irradiation

3 Cystic changes suggestive of long standing disease, or a very large lesion upon which X-ray therapy would probably have little effect.

4 Evidence of further growth of the adenoma after a course of irradiation of the dosage listed above (Additional irradiation would be hazardous)

5 An indefinite diagnosis clinically which calls for an exploratory operation (If a pituitary adenoma is found, post-operative irradiation may be employed)

ENDOCRINE MANAGEMENT

The preparation of the patient for operation calls for the administration of exogenous adrenal steroid compounds for the following reasons

1 Unless time-consuming tests for adreno-cortical reserve are done, one cannot be certain that a debilitated pituitary adrenal axis will be capable of responding adequately to the stress of a surgical procedure.

2 In order to obtain adequate removal of the adenoma, it may occasionally be necessary to eviscerate the contents of the sella turcica including the remnant of functioning adeno-hypophysis. Adreno-cortical tropic secretion would cease as of that moment and adreno-cortical collapse could be predicted within 24 hours. In past experience, the importance of this phenomenon was not realized and some of our unexplained deaths after hypophysial operations were undoubtedly caused by acute hypopituitarism.

3 No untoward complications due to steroid therapy have been observed in patients receiving cortisone before, during, and after surgical interference Of equal importance, also, is the maintenance of adequate electrolyte balance.

In our clinic, cortisone (compound E) has been used as the agent of choice, although compound *F* may ultimately replace cortisone when an intra-muscular preparation becomes available.

The administration of active adreno-cortical compound is preferred to the use of adreno-cortical tropic hormone because the response to intra-muscular administered ACTH, either the aqueous or the gel preparation, is not predictable. The rate of absorption or local inactivation of the agent in the muscle is variable. (See Table II)

TABLE II.

PRE-OPERATIVE AND POST-OPERATIVE CORTISONE SCHEDULE.

Day	Milligrams of Cortisone (Intramuscular) According to the Weight of the Patient		
	30-40 lbs.	70 90 lbs.	130 lbs. or more
48 or 36 hours pre-operatively	75	100	200
24 hours pre-operatively	75	100	200
6 A. M. day of operation*	50	50	100
Post-operatively, first two days	25 q 8 hours	25 q 6 hours	50 q 6 hours
3rd P O day†	25 q 12 hours	25 q 8 hours	50 q 8 hours
4th P O day	25	25 q 12 hours‡	50 q 12 hours‡
5th P O day	12½	25	50
6th P O day	12½	12½	25

Hydrocortisone (Compound F) is also kept on hand in the operating room for emergency intravenous administration (25 mg stat and 10 mg per hour by continuous drip thereafter) in case of sudden peripheral vascular collapse This has never occurred however in a patient who was prepared for operation with cortisone according to the above schedule

† The rapidity with which cortisone administration is tapered off depends upon the speed of convalescence of the patient.

‡ When the patient is taking food, cortisone may be given orally instead of intramuscularly in divided doses throughout the day

TECHNIQUE OF OPERATION

There is no need here for a detailed description of the submucous resection of the septum There are a few maneuvers perhaps about which one might quibble, but on the whole our objective is to perform a satisfactory septum operation, control bleeding, and obtain a good view of the rostrum of the sphenoid The latter structure which forms the anterior wall of the sphenoidal sinus is removed as extensively as possible in order to permit a good view of the sinus cavity At this stage it is often discovered that the floor of the sella has been eroded and that the tumor is presenting within the sphenoidal sinus Its capsule is then incised and the contents of the lesion removed with curettage and suction This can be accomplished with considerable ease when the lesion is truly the chromophobe type and growing downward into the sinus cavity If the floor of the sella is intact, this must be removed with chisel and biting forceps to expose the capsule of the tumor so that the latter may be incised and contents evacuated Every effort should be made to remove the anterior and inferior circumference of the capsule as extensively as possible, care being taken to avoid the lateral walls which lie in intimate relationship to the internal carotid arteries

It is to be emphasized that one can usually remove as much of the capsule of the tumor through a trans-sphenoidal exposure as can be accomplished from above by turning a fronto-temporal flap The neurosurgeon does not attempt to peel the capsule of a chromophobe adenoma off the internal carotid arteries and the cavernous sinuses nor should the rhinologist undertake such an extensive procedure by his method of attack This is not necessary The accomplishments in terms of amount of capsule removed are approximately the same by both methods, and obviously much less formidable and hazardous when the intranasal route is employed It is desirable to expose the sphenoidal sinus widely and to drain it into one of the nasal cavities through a vertical incision in the posterior extremity of one of the septal flaps A Penrose drain introduced through the nares into the sphenoidal cavity may be employed for two or three days after the operation The septal flaps are then approximated by any of the numerous methods which the rhinologist has been accustomed to employ Fortunately, pre-operative preparation of the patient with antibiotics and chemotherapeutic agents and post-operative support by their continued administration now allay our fears of the serious complications which frustrated our efforts to use this operation successfully in the early decades of the century

CONCLUSIONS

1 The chromophobe adenoma of the pituitary can produce a variety of signs and symptoms by pressure upon neighboring structures and disturbances of endocrine functions of the gland The common initial and obvious clinical symptoms are headache and blurred vision.

2 The radiographic examination of the skull usually furnishes the final clue to the identity of the lesion In this connection angiography is of utmost importance in determining the size of the adenoma and position of the internal carotid arteries.

3 Recent scientific investigations of the functions of the pituitary adrenal axis furnish us new and important knowledge referable to the pre-operative and post-operative endocrine management of the patient.

4 It is generally conceded that the trans sphenoidal approach to the chromophobe tumor can accomplish its resection as effectively as the more hazardous procedure of turning an osteoplastic flap in the fronto-temporal region The adenoma is usually soft, cystic in architecture, with a brownish syrupy contents which can be removed by curettage and suction. Neither the neuro-surgeon nor the rhinologist should attempt complete eradication of the lesion Our experience with X-ray therapy has been discouraging in that many patients who have been exposed to this form of therapy have eventually come to operation.

5 The effects of the operation are often spectacular Vision frequently returns several hours later, and the headaches are often relieved before the patient is returned to his room. It goes without saying that the patient must invariably have the protection of the antibiotics and possibly also the chemotherapeutic agents against post-operative meningitis.

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EPISTAXIS—EVALUATION OF SURGICAL CARE *

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In 1947, at the conclusion of my resident training program, I had occasion to be associated in the care of a physician with epistaxis During the first week of hospitalization he had recurring bleeding in spite of anterior and posterior nasal packing under anesthesia. He went on to develop the usual anxiety over his predicament, and inspired the development of a surgical approach for ligation which was effective, quickly curative, non-disabling, and surgically sound

His individual reaction the day after surgery, comfortable, without bleeding or nasal packing, was "Why the hell didn't you do this in the first place?' Fortunately, most cases of epistaxis do not require surgical ligation for definitive therapy, however, the question arises is our conservatism and reluctance to use surgical therapy justified, and if so, when do we draw the line and intervene?

An analysis of the medical literature and hospital records came subsequent to this event, and with it the stimulus to create a program for definitive care of serious epistaxis in accord with accepted basic surgical principles.

Spontaneous hemorrhage from the nose is a frequent occurrence in the practice of medicine In the vast majority of these patients the arrest of hemorrhage is either spontaneous, self-controlled, or easily managed by local therapy at the office Such local therapy takes the form of electro-coagulation, topical application of coagulants and escharotics, pressure packing of various forms, and many other methods advocated by individual reports in the literature.[1-5]

In the main these methods are equally effective, if not equally efficient in controlling hemorrhage, because the point

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of bleeding is visible and can be exposed to direct local attack by any of the therapeutic procedures There remains, however, a group of cases where bleeding is persistent and recurrent, and the loss of blood is so profuse that a serious state of anemia and shock with possible death ensues To these cases we have affixed the diagnosis of serious epistaxis, for they create a problem demanding serious consideration as to therapy and cause great anxiety to all individuals concerned

For the purpose of this discussion, serious epistaxis refers to those patients having persistent nasal bleeding who, because of the excessive loss of blood, require preliminary emergency anterior and posterior nasal packing for the control of bleeding and hospitalization for definitive treatment, it does not include cases of anterior bleeding which can be localized and easily controlled by coagulation or localized pressure by spot packing

Modern textbooks in otorhinolaryngology devote little consideration to the subject of serious epistaxis and the management of this problem, leaving one with the impression that this condition does not occur so frequently as a review of the literature would indicate Ogura and Senturia,[6] reporting in 1949, cited their investigation of 130 cases requiring hospitalization over a 15-year period, these were not all cases of severe bleeding as defined within the limits of this paper Hallberg, reporting from the records of the Mayo Clinic, cited 212 cases over a 20-year span At the Eye and Ear Hospital, University of Pittsburgh, uncontrollable epistaxis requiring packing and hospitalization accounted for 235 admissions in the five-year period from 1947 to 1951, or an average of 47 cases per year, of these, 10 required surgical intervention other than packing This admission rate is comparable to the admission rate for other common otorhinolaryngological procedures The average hospital stay of the patients was 10 to 12 days, thus surpassing comparative figures for most other conditions requiring hospitalization in otorhinolaryngology

It is not the purpose of this analysis to discuss the problem of epistaxis from the standpoint of etiologic factors In the specialty of rhinology, serious epistaxis must be accepted as a primary condition requiring specific therapy The treatment of the causative diseases which have epistaxis as an associated symptom is not considered when developing a therapeutic regime for the immediate management of these cases

It is commonly agreed that serious epistaxis is a problem of advancing years, occurring with increasing severity and frequency in individuals over 45 years of age. The pathologic changes in the blood vessel walls of the aged, resulting in fibrosis with loss of their inherent ability to control bleeding by retraction and contraction, account for the high percentage of cases recognized as being secondary to hypertensive and arteriosclerotic vascular changes.

Another factor responsible for spontaneous arrest of hemorrhage is clotting due to the end reaction of thrombin and thromboplastin, unfortunately, this alone is often inadequate for spontaneous control of bleeding from vascular channels the size of those involved in severe epistaxis Blood dyscrasias, inflammations, systemic diseases, neoplasms, organic nasal disorders, and trauma are other common diseases which frequently have associated epistaxis They are of secondary importance, however, in the treatment of this emergency problem.

Reporters to the medical literature over a period of years have been in agreement on the academic questions of etiology, incidence, and anatomy The morbidity and mortality associated with epistaxis have been recognized There is disagreement, however, on a definitive plan of therapy for effective and efficient permanent control of severe bleeding from the nose except that "ligation may be a life-saving procedure." [8-10]

The relationship of the vascular supply to the surgical landmarks of the interior of the nose is of importance in determining the means of controlling bleeding by surgical intervention

Severe epistaxis is associated with bleeding from the anterior ethmoid or sphenopalatine arteries While the latter artery is the predominant of the two there is an intimate anastomosis of their septal and lateral nasal branches They are terminal branches of the external and internal divisions of the carotid system The external carotid artery enters the nose as the sphenopalatine division of the internal maxillary artery and supplies the posterior and inferior two-thirds of the medial and lateral wall of the nose On emerging from the sphenopalatine foramen in the middle meatus, it then crosses in the mucosa of the anterior inferior border of the sphenoid sinus and separates into a lateral nasal and medial septal division

The lateral branch descends to supply the mucosa over the inferior turbinate and its meatus The vessel anastomoses with the nasal branches of the descending palatine artery The medial division of the artery terminates on the septum by anastomosing with the ethmoidal arteries and the septal divisions of the superior labial artery from the external maxillary portion of the external carotid artery The internal carotid system terminates in the nose as the anterior and posterior ethmoidal vessels, the latter arteries are of small caliber and, like the septal branches of the external maxillary, are unimportant except for the anastomotic pathways they contribute The anterior ethmoidal artery takes origin in the orbit from the opthalmic artery and enters the nasal space from the medial wall of the orbit It enters the nose from the crista galli and supplies the mucous membranes lining the sinus spaces above the middle turbinate and also gives off meningeal branches to the dura

The middle turbinate is the anatomical landmark dividing these two main arterial systems Bleeding from the anterior ethmoid artery is anterior and superior to the middle turbinate, while bleeding from the sphenopalatine is located posterior and inferior to the turbinate

The carotid system is unique in regard to its multiple pathways of anastomosis The internal carotid artery, which is free of branches in the neck, has a free anastomosis at the Circle of Willis with the corresponding vessel of the opposite side The capability of this anastomosis to maintain cerebral blood flow was demonstrated by the experimental work of Shenkin[11] and his co-workers Dandy[12] and Sweet,[13] reporting on changes in pressure associated with carotid ligation, also verified the ability of this collateral circulation to develop and maintain pressure

Matson and Woodhall,[14] investigating the effects of ligation of the internal carotid artery, proximal or distal to the cavernous sinus, failed to produce blindness through thrombosis

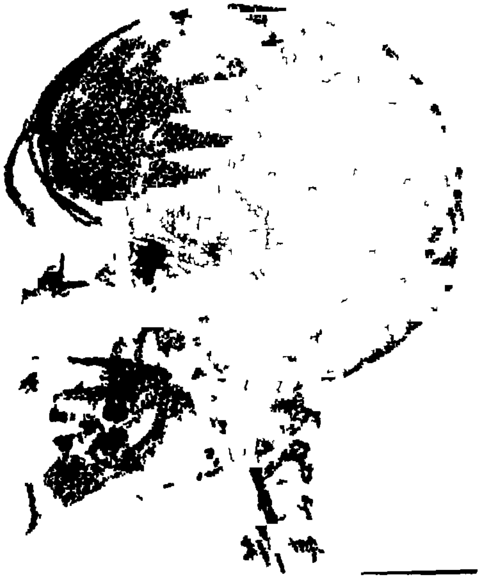

Fig. 1 Arteriography of the carotid system demonstrating the multiple, closely related anastomotic pathways. Lateral view

of the ophthalmic artery This was offered as clinical proof of the rich anastomosis between the ophthalmic artery and orbital branches of the external carotid artery This was confirmed by studies of Walsh and King[15]

Fig 2 Arteriography of the carotid system demonstrating the multiple closely related anastomotic pathways Anterior-posterior view

The external carotid artery has nine main branches and many secondary branches between its origin from the common carotid artery and the termination in the nose as the sphenopalatine artery The anastomotic pathways between these various branches and their corresponding branches of the opposite side have been described anatomically[16] and demonstrated surgically Wiley and Sugarbaker[17] reported on the ineffectiveness of unilateral external carotid ligation for control of bleeding in cases of malignancy about the maxilla, they demonstrated the effectiveness of bilateral temporary or "tourniquet" ligation of these vessels The significance of this vast anastomotic pattern has been demonstrated by the neurosurgeons and by arteriography of the carotid system[18] (see Figs 1 and 2)

The control of hemorrhage is a basic principle which has been recognized and accepted from the beginning of surgery Permanent control of hemorrhage is obtained by cauterization pressure, or ligation[19]

The efficiency of cauterization by thermocautery is dependent on the searing of tissues This procedure is satisfactory in controlling hemorrhage in cases of simple epistaxis but is unreliable where bleeding is from larger arteries generally invisible because of their posterior position in the nose

In general, surgical control of bleeding is obtained through use of a hemostat, while in rhinology pressure control of bleeding is usually dependent on packing The effectiveness of nasal packing is dependent upon spot pressure at the bleeding site when it is visible or spot packing over the proximal portion of the bleeding vessel in all other cases Packing must, therefore, be directed between the middle turbinate and septum and laterally over the anterior wall of the sphenoid sinus toward the sphenopalatine foramen

Such pressure is best obtained by using one-half inch mesh gauze, commonly referred to as mastoid packing and placing it in this position with a Freer submucous elevator If properly inserted this should immediately control all nasal bleeding secondary to sphenopalatine artery rupture When bleeding is uncontrolled the packing should be continued forward to the anterior and superior portion of the middle turbinate so as to compress ethmoidal vessels and anastomotic channels of the ethmoid and sphenopalatine arteries

The effectiveness of this packing is dependent on the precision of its insertion and the firmness of pressure. It is most efficiently inserted under anesthesia with a posterior plug in place. One cannot accomplish this end result in a restless, uncooperative, anxious individual without anesthesia Failure to control bleeding with this procedure is generally due to incomplete removal of blood clots from the nasal space prior to insertion of the packing or inefficient, loose packing which permits continuous oozing and clotting of blood in pockets between the gauze

Removal of the packing is accomplished in multiple stages After 72 hours a portion of the packing is withdrawn, the amount removed is usually indicated by the first appearance of blood staining on the gauze This process is repeated daily until all the packing has been removed Vascular ligation is reserved for those cases where bleeding has recurred in spite of precision packing Ligation should be resorted to when continued bleeding endangers the patient's life due to progressive ischemia, lowered blood pressure, tachycardia, cardiac insufficiency, and coronary occlusion

Ligation is a permanent curative procedure only when performed according to the accepted surgical principle of terminal ligation of vessels for control of hemorrhage In the historical analysis of ligation for the control of epistaxis there were advocated procedures which failed to conform to this principle The earliest surgical approach was that of common carotid artery ligation as advocated by Abernathy[20] in the 18th century It is commonly accepted today, in spite of occasional reports in the literature, that common carotid artery ligation is unjustified because of its inefficiency and high mortality rate

Ligation of the common carotid artery will restrict only 50 per cent of the flow of blood through the internal carotid artery The ethmoidal and sphenopalatine circulation will be unaffected because of the adequacy of the Circle of Willis and its collateral circulation The mortality rate for this procedure is expressed by various authors[22-23] as 15 per cent or higher because of the sudden closure of cerebral circulation in patients already anemic and undergoing cardio-vascular stress

Internal carotid artery ligation is a more dangerous and undesirable procedure than common carotid artery ligation

Voris,[24] in reporting a series of 149 cases, noted complications varying from permanent sequela to death in 57 per cent of the cases Complications arise because of the immediate cerebral ischemia in the territory supplied by the internal carotid artery or because of delayed embolism or thrombus from the site of ligation

Rogers[25] reported that ligation of the internal carotid artery is to be avoided as a primary procedure. Dandy,[26] in evaluating the inefficiency of this procedure in controlling bleeding, classified it as a "preoperative procedure" This was due to the rapid re-establishment of cerebral vascular pressure following ligation and thus its inefficiency in controlling ethmoidal bleeding

In the past 50 years ligation of the external carotid artery has been advocated and commonly accepted as the method of choice for control of severe nasal bleeding This development is probably related more to the recognition that its terminal branch, the sphenopalatine artery, is the most frequent source of bleeding than to the evaluation of the physiological efficiency of the procedure however there remain a number of uncertainties related to the procedure, particularly with respect to the long-term prognosis and the effectiveness of such proximal ligation in controlling bleeding from a main artery with a rich collateral circulation

Available data is particularly meager with respect to the long-term prognosis of this procedure Barker,[27] Johnson and Foster[28] reported the recurrence of nasal bleeding due to reestablishment of collateral circulation within a week after ligation These results seem comparable to the situation expressed by Dandy in evaluating the effectiveness of internal carotid artery ligation The surgical axioms for control of hemorrhage established by surgeons of accepted reputations and experimental studies do not sustain this procedure

Halsted,[29] in discussing surgical ligation, stated that the closer to the heart the ligature is placed, the greater is the likelihood that collateral circulation will be re-established The physiologic response to such a ligation is a rise in blood pressure and a dilatation of the collateral circulation to compensate for the loss induced The segment distal to the ligature shows an immediate loss of pressure, followed by gradual rise and the return of pulsation[30] While some authors[31-33] advocate this procedure because of its simplicity, difficulties and complications have been reported Difficulty of exposure due to abnormally high division of the common carotid artery in the neck was reported by Davis,[34] who also noted frequent difficulty due to an overlying venous plexus

Laryngeal and pharyngeal edema, unilateral paralysis of the tongue, and wound infection requiring tracheotomy have been reported as complications of the procedure[7] Recurrence of bleeding has been reported frequently[27-28] Some authors[35-36] claim that where bleeding is uncontrolled by external carotid ligation, a secondary procedure for ligation of the ethmoid artery through the orbital approach has been effective This assumes mis-diagnosis of the bleeding point as the reason for failure

Hirsch[37] and Davis,[34] however, admitting the existence of the ethmoid artery as a source of bleeding, explain the recurrence of bleeding as a result of the efficient collateral circulation They, therefore, advocate the procedure of trans-antral ligation of the internal maxillary artery, as described by Seifert,[38] as a more effective procedure in that it affords an opportunity to cut off the arterial supply as close as possible to the site of hemorrhage, thus obviating the intermediate anastomotic branches

Anterior ethmoid and internal maxillary artery ligation, as advocated by Hirsch,[37] conforms to the surgical principles of terminal ligation of vessels for control of hemorrhage Criticism of the procedure, based upon technical difficulties, seems to be unwarranted by experienced rhinologists Perhaps the words of one of our eminent surgeons are apropos "It is frequently not the patient but the surgeon who is inoperable"[39]

The close relationship of the ethmo-sphenopalatine anastomosis and the severity of hemorrhage frequently preclude an exact diagnosis as to the origin of bleeding Ligation of the external carotid or internal maxillary artery, at any point along its course is, therefore, commonly undertaken on the basis of frequency of bleeding from the sphenopalatine artery

Where such a procedure fails a second operative approach for ethmoidal ligation becomes necessary

As the result of my experience and that of others reviewed above, it became apparent that many surgical methods used to date for control of nasal hemorrhage have resulted in undesirable side effects and not infrequently have failed to achieve the primary aim of adequately controlling the hemorrhage In order to circumvent these objections a modification of the fronto-ethmoid approach for exenteration of sinus disease, as originally advocated by Yankauer[40] and modified by Lynch, Ferris-Smith and others, was first employed by McCollough and myself in 1947

Because of the psychologic stress and apprehension of the patient, we perform the operation under general anesthesia after temporary control of bleeding by means of nasal packing The anterior ethmoid artery is exposed through a fronto-ethmoid incision. This exposure is easily maintained with the all purpose, self retaining retractor of McCollough Non-absorbable material, silk or cotton, is preferable for ligating the artery Placement of the ligature about the artery with the carrier and tier of Ferris-Smith simplifies the procedure The efficiency of this ligature can be tested by removing all nasal packing and noting the effect on the bleeding when the ligature is tied

If bleeding is arrested, the surgical procedure may be considered completed If bleeding persists, the ethmoid labyrinth is exenterated, and the anterior wall of the sphenoid sinus is exposed The mucosa is elevated from the anterior inferior wall of the sphenoid sinus, and a silk ligature inserted through the extreme lateral position so as to include the sphenopalatine artery as it enters the nose from its foramen This ligature is also inserted with the ligature carrier and tier All nasal packing is then removed to establish the fact that bleeding is controlled.

Since this procedure was adopted in 1947 it has been utilized in 12 cases of serious epistaxis when spot packing under anesthesia was ineffective A survey of the cases (see Chart 1) operated by the fronto-ethmoid approach reveals that ligation of the anterior ethmoid artery or both the anterior ethmoid

CHART 1 SUMMARY—CASES OF SEVERE EPISTAXIS REQUIRING LIGATION

Case	Sex Age	History	Therapy and Result
1 E D 1947	M 58	Recurring left sided bleeding for two weeks Uncontrolled with precision packing under anesthesia during 17 days of hospitalization	Ligation of anterior ethmoid and spheno palatine left. No packing Discharged four days post-operative No recurrence Cured
2 E G 1949	F 45	Recurring bleeding for many years with three severe episodes requiring hospitalization Unable to maintain her job and worried about recurrence Always left sided	Ligation left anterior ethmoid and sphenopalatine No packing No recurrence Cured
3 W T 1950	M 26	Recurring bleeding for one month treated by family doctor Emergency admission with anterior and posterior packing Ligation performed because of recurrence of bleeding and repeated therapy with anxiety	Ligation of left anterior ethmoid and sphenopalatine artery performed No post operative bleeding Secondary finding at operation malignant nasopharyngeal tumor treated with X ray Living and well
1 G B 1950	F 60	Persistent bleeding, secondary to hypertension, in spite of packing Bleeding point superior	Anterior ethmoid ligated with control of bleeding No post-operative packing Discharged in five days Cured
5 R M 1951	M 56	Persistent bleeding secondary to hypertension Packing not effective Patient apprehensive Bleeding point posterior, right	Anterior ethmoid and sphenopalatine ligation, right. Discharged five days post operatively Recurrence of mild bleeding 1953 and again in 1954 Controlled with packing Hospitalized 72 hours and 96 hours
6 B M. 1951	M 55	Recurring bleeding for 30 years, requiring frequent hospitalization and transfusions Previous therapy included submucous coagulation and packing Twenty transfusions during one hospitalization Eighteen transfusions at present hospitalization Bleeding bilateral Secondary to idiopathic telangiectasia.	Two-stage bilateral ligation nine days apart Severe bleeding satisfactorily controlled Discharged 18 days post operatively Has had mild episodes of bleeding from septal branches of external maxillary artery in anterior nasal space Controlled c̄ cautery and packing

CHART 1. SUMMARY—CASES OF SEVERE EPISTAXIS REQUIRING LIGATION Continued

Case	Sex Age	History	Therapy and Result
7 N B. 1952	M 38	Recurring bleeding for one week secondary to hypertension. Admission to the hospital after repeated packing and care by family physician R.B C 3,500 000—H by 50% Bleeding persisted in spite of precision packing R.B C. 1 890 000	Ligation left anterior ethmoid and sphenopalatine Discharged five days post-operative. No recurrence Cured
8 A. L. 1952	M. 58	Bleeding posteriorly Hypertension, hyperplastic sinusitis and nasal polypi right. Persistent bleeding in spite of precision packing.	Ligation right anterior ethmoid and sphenopalatine artery Discharged five days post-operative No recurrence Cured
9 T G 1952	M. 43	Recurring bleeding of undetermined origin uncontrolled by repeated nasal packing Associated hyperplastic sinusitis and polypi	Ligation right anterior ethmoid and sphenopalatine artery No packing post-operative Discharged six days after surgery No recurrence Cured.
10 F H 1953	M 45	Repeated nasal bleeding for 24 hours R.B C on admission 3 860 000 Persistent bleeding in spite of packing on repeated occasions	Ligation right anterior ethmoid and sphenopalatine artery Discharged seven days post-operative No recurrence Cured
11 J M 1953	M 46	Recurring bleeding over period of three weeks in spite of packing under anesthesia	Ligation anterior ethmoid with complete control and discharge from the hospital four days post-operative No recurrence Cured.
12 A. M 1954	M 56	Recurring bleeding for 34 years because of familial telangiectasia. Hospitalized in Medical Service Veterans Hospital in February 1954 Repeated nasal packing and recurrence of bleeding until anxiety of patient demanded more definitive treatment.	Ligation anterior ethmoid and sphenopalatine with complete post-operative control and release from the hospital one week post-operative No recurrence

and sphenopalatine arteries has been completely effective for control of hemorrhage in all cases to date Post-operative period has been free of complication, and cardio-vascular and psychologic stresses have been neutralized

One patient, aged 55, with a history of epistaxis for 30 years and two episodes of hospitalization for uncontrollable bleeding, requiring as high as 20 blood transfusions, had bilateral ligation performed within a period of one week In the three years following surgical ligation he has been free of bleeding Another case of severe nasal bleeding secondary to congenital telangiectasia had required repeated transfusions in the course of 15 hospital admissions during the past seven years There has been no further bleeding since this procedure was performed eight months ago

SUMMARY

Serious epistaxis has been presented as a problem worthy of evaluation because of the frequency of its occurrence, distress to the patient, questionable therapy, and serious sequelae An attempt has been made to elucidate the adequacies and inadequacies of past surgical procedures from the standpoint of acceptable surgical axioms for the permanent control of hemorrhage

The use of the fronto-ethmoid approach as a one-stage procedure for terminal ligation of the anterior ethmoid and sphenopalatine arteries is offered as an alternative to the two-stage procedure of ethmoid artery ligation when trans-antral ligation of the internal maxillary artery is ineffective

The justification for use of the fronto-ethmoid approach is based upon the clinical results of the 12 cases reported and the resolution of the anatomic and physiologic objections to the other surgical procedures

The surgical procedure should be familiar to every rhinologist trained in the care of nasal and sinus disease It should be part of the armamentarium of the rhinologist in controlling severe epistaxis when emergency packing and spot packing under anesthesia have failed

CONCLUSION

From this analysis of the past and present surgical care of severe nasal hemorrhage, the following conclusions are apparent

1 Persistent and uncontrolled epistaxis may cause serious complications due to cardio-vascular stress

2 Fatalities have been reported due to inadequate therapy

3 During episodes of severe epistaxis, it is *frequently impossible* to determine the source of bleeding

4 Persistent nasal bleeding creates a severe psychologic stress for the patient, making it desirable to utilize general anesthesia for carrying out therapy

5 Severe nasal hemorrhage is usually associated with rupture of the anterior ethmoid or sphenopalatine arteries.

6 Permanent surgical control of nasal bleeding can be obtained by terminal ligation of vessels

7 Ligation of a major vessel to control bleeding from its lesser branches is unsound

8 Ligation of the common or internal carotid artery is inefficient and hazardous

9 Ligation of the external carotid artery is not always a simple procedure and has been followed by undesirable complications

10 Recurrence of nasal bleeding from collateral circulation subsequent to external carotid ligation has been reported

11 Secondary procedures for ethmoid artery ligation have frequently been necessary due to "mis-diagnosis" of the bleeding point

12 Terminal ligation of vessels for effective control of nasal hemorrhage can be accomplished through the fronto-ethmoid approach.

13 Criticism of a rhinologic surgical procedure on the basis of technical difficulties is unwarranted by those adequately trained in rhinology

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CANCER OF THE EXTERNAL AUDITORY MEATUS*†

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Cancer of the ear, nose or throat is a morbid disease which is less or more morbid, depending on several specific factors. The differentiation of the cells, the rate of growth, the rapidity of metastasis, and the bio-physical bed of the host, all decrease or increase the chances for cure, however, one factor concerning cancer of the auricle, so important that it is the moving force for the investigation reported in this paper, is that of location.

Innumerable articles have been written about the poor prognoses of cancer located in the posterior third of the larynx as compared with the anterior third, even when exactly the same pathology may be observed under the microscope This same factor, location, seems to be of even greater importance in cancer of the auricle which develops within 1 centimeter of the external auditory meatus This must be pointed out because the degree of radicalism employed by the otologic surgeons depends upon the possible extent of the tumor he visualizes grossly

The most common types of cancer in this area are the squamous cell carcinoma, the basal cell carcinoma, and the cylindroma.

In our series of 88 cases we have 45 squamous cell carcinomas and 35 basal cell carcinomas, which together make up 91 per cent of the entire series There were also two cylindromas and two adenocarcinomas It is not pertinent to this paper to discuss other less common types of cancer which have been found in this area.

Although it is well known that the epidermoid carcinoma is much more likely to metastasize by way of the lymphatics into

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the neck, many of us have been lulled into a false sense of relative security by the pathologist's report of the so-called low grade malignancy called basal cell carcinoma. It is an established fact that such a lesion in other areas of the head, including the periphery of the auricle, is usually a low grade, slowly growing affair that can easily be handled in most instances either by X-radiation or with a 1 centimeter margin if treated surgically, however, our own experience teaches us that basal cell carcinoma within 1 centimeter of the external auditory meatus may act either like a docile lamb, a fox, or occasionally an octopus.

Basal cell carcinoma may remain localized, and even after being erroneously treated with ointments and antibiotic preparations by an unknowing physician over a long period of time eventually can be removed safely with a 1 centimeter margin, and never recur This can be called the docile lamb type.

On the other hand a basal cell carcinoma with the same gross appearance and showing an ulcerated center, unknown to the physician, may surreptitiously grow beneath the surrounding skin for a distance of 2 to 3 centimeters and not even be palpable to the most careful observer This may be called the fox-like type.

Finally, the type that gives the most concern is the basal cell carcinoma that may also present the same localized small ulceration described previously, but like an octopus, infiltrates and sends its cells along the peri-neural lymphatic pathways, dichotomous-like, and become the most difficult to eradicate.

At this point I must confess that I have not been able to determine clinically early enough what might be the nature of the beast. If this were possible then some of the conclusions about the proper therapy, drawn from my observations, would no longer be valid.

Figure 1 tells a part of the sad story of a man who was subjected to repeated surgery for basal cell carcinoma over a period of 17 years and finally culminated in death, due to extension of disease to the cerebellum. The disease process at the last procedure performed revealed the cancer cells to have penetrated to the vertex of the scalp, 6 centimeters from the ulcer periphery, with no clinical evidence of such disease being present at this point.

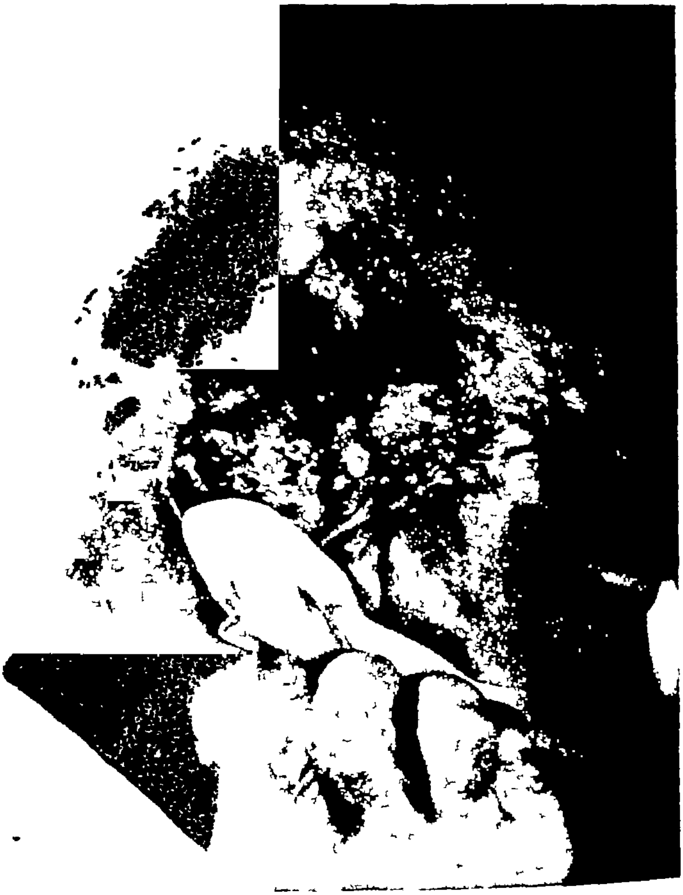


Fig 1

A word about the cylindroma The pathologist as well as the clinician must be extremely careful to distinguish between the so-called basal cell carcinoma of skin origin and the cylindroma that finds its way via the anterior portion of the external auditory meatus from its site of origin in the parotid gland Not infrequently there is no clinical evidence for swelling of the parotid gland in the region of the tragus, and yet an ulcerated tumor mass may present itself within 1 centimeter of the external meatus.

One of our cases was treated by local excision at first for what was reported as basal cell carcinoma of the external meatus, but as recurrence took place within a few months it became obvious that the tumor was a cylindroma that arose in the tail of the parotid gland and worked its way into the external auditory meatus. More radical surgery was, therefore, undertaken

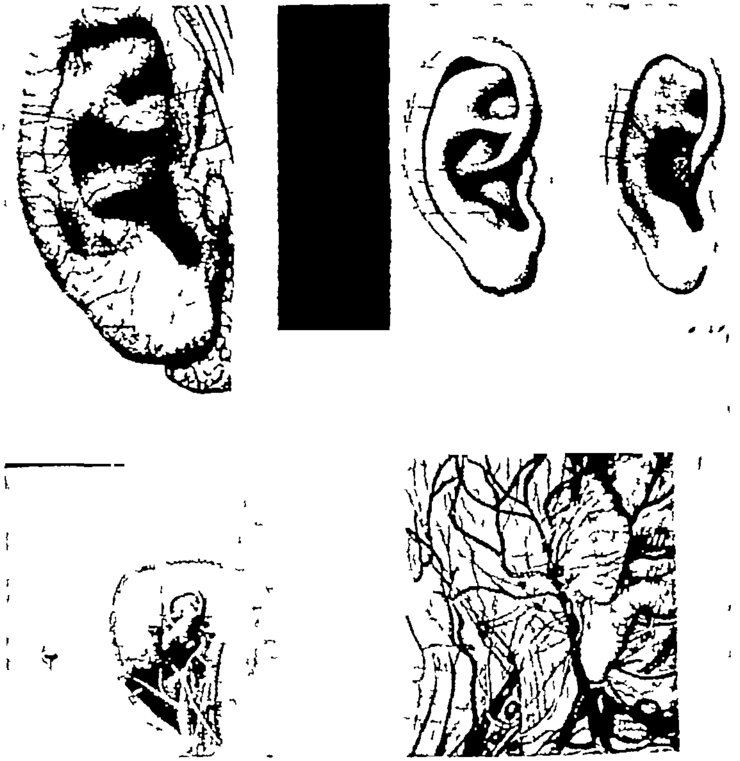
It is self evident in such cases that surgery of the auricle must also include excision of the parotid gland, even sacrificing the facial nerve if essential for establishing a cure The first operation is usually the one real chance for cure in these cases.

The high rate of failure to produce cures in cancer of the auricle in which the disease appears within a centimeter of the external auditory meatus compares unfavorably with statistics for cures in other areas within the realm of otolaryngology The cure rate definitely is not reflected in the 95 per cent cures obtained in skin cancer in general.

The material for this report was drawn from the records of 88 cases treated over the past 25 years at the Massachusetts Eye and Ear Infirmary, the Massachusetts General Hospital, and Pondville Hospital, a Massachusetts state institution devoted entirely to cancer work All cases which did not specifically present themselves as neoplasm within 1 centimeter of the external auditory meatus were excluded on the clinical basis that lesions of the periphery of the auricle usually respond to therapy as well as skin cancer in general and, therefore, were not pertinent to this report.

The location of the tumor near the external meatus is more serious, partly because of the nature of the lymphatics in this region. For example, Fig 2 A and D represents Belov's demonstration of the lymphatics of the auricle and external meatus. This cutaneous network contains three groups the first, a posterior group, included the region of the helix, the antihelix, triangular fossa, the whole of the internal surface and the posterior portion of the external auditory meatus They number 6 to 12 and end in the mastoid glands for the most part, some by-pass them and go directly to the upper deep cervical nodes

(A) Belov (B) Sappey's



(C) Most. (D) Belov

Fig 2

(A and D) BELOV Altas de Anatomie del organa del oida y de L & S Region con e vinculadas Buenos Aires Oceana 1930

(B) SAPPEY Traite d anatomie descriptive Ed Vol. 3 Paris Lecrosnier et Babe (Fig 727) 1889

(C) MOST AUGUST Die Topographie de Lymphgefass und Apparate des Kopfes und des Halses Berlin 1906

The second, the inferior group, drains the inferior portion of the external auditory meatus, the lobule, and adjacent portions of the auricle Some drain into the sub parotid group and some directly to the upper deep cervicals

The third and anterior group contains four to six trunks and drain the concha and anterior wall of the external meatus and empty into the pre-auricular glands

Figure 2 B represents a beautiful dye injection demonstration by Sappey, and shows the tremendous number of lymphatics within a 1 centimeter area of the external auditory meatus With this picture in mind it is not difficult to presuppose that cancer in this region can readily be a more morbid disease.

This photograph demonstrates the mastoid or retro-auricular glands, usually two in number, that lie on the mastoid insertion of the sternomastoid muscle These drain the temporal portion of the scalp, the internal surface of the auricle with the exception of the lobule, and also receive afferents from the posterior surface of the external auditory meatus The efferents from this gland go to the upper deep cervical group under the sternomastoid muscle.

In determining what happened to these 88 patients it must be pointed out that not only otologists but also general surgeons treated many of them Forty-one of the cases were treated by general surgeons and 26 were treated by otologic surgeons. The rest were treated with X-radiation The oldest patient in this group at the age of onset of the disease was 94, the youngest 32 A further breakdown in this age group, pertinent in view of the numbers in the middle age group, is shown in Table I

TABLE I — AGE OF ONSET

30-39 years old	5
40-49 years old	12
50-59 years old	13
60-69 years old	31
Over 70 years of age	27

About one third of the cases occurred in those under the age of 60 Incidentally 65 were males compared with 23 females, a ratio of about 3 1

TABLE II — SURVIVAL RATE.

No of patients in series	88
No of survivals without clinical evidence of cancer	
5 years	35
7 years	22
10 years	14

TOTAL—15 8 PER CENT 10 YEAR CURE RATE

The usual criteria for five-year survival without obvious recurrence did not seem to apply to cancer in this area. This is significant when one reports the so-called five-year survivals and notes the dwindling figures as seven years and ten years are reached, however, this chart deserves further clarification. Many of the 74 uncured patients continued to live with disease for as long as 15 or more years, receiving intermittent treatment by surgery or radiation at one time or another, also, two-thirds were 60 years of age or older, and died of other disease despite the persistence of the ear cancer.

The criteria as to the size of the presenting lesion were reviewed, and it is of striking interest that size mattered very little, since the largest and smallest groups showed the same poor end results Let us break this down further

TABLE III — SIZE OF PRESENTING LESION

Size — less than 1.0 cm	11	in series
5 year survival without obvious disease	4	
7 year survival without obvious disease	2	
10 year survival without obvious disease	1	
Size — 1.0 cm to 2.0 cm	39	in series
5 year survival without obvious disease	20	
7 year survival without obvious disease	13	
10 year survival without obvious disease	9	
Size — 2.5 cm to 5.0 cm	25	in series
5 year survival without obvious disease	9	
7 year survival without obvious disease	6	
10 year survival without obvious disease	3	
Size — larger than 5.0 cm	9	in series
5 year survival without obvious disease	2	
7 year survival without obvious disease	1	
10 year survival without obvious disease	1	

Even though most of the 10 year survivals had 1.0 to 5.0 centimeter size lesions at the onset, the poorer showing of the smallest and largest lesions demonstrates that very little importance can be attached to the relative size of the presenting lesion in this area

What about the pathology insofar as chances for cure are concerned?

TABLE IV — PATHOLOGY

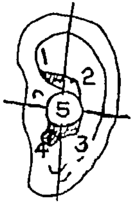
Basal cell	35 cases
5 year survival without obvious disease	21
7 year survival without obvious disease	15
10 year survival without obvious disease	9
Squamous cell	45 cases
5 year survival without obvious disease	12
7 year survival without obvious disease	6
10 year survival without obvious disease	4
Cylindroma	2 cases
5 year survival without obvious disease	1
Adenocarcinoma	2 cases
10 year survival without obvious disease	1

The type of pathology in relation to cure shows a ratio of about 2 8 basal cell carcinoma 10-year cures to one of squamous cell origin. One would ordinarily expect a higher ratio of basal cell cures, in view of the relative benignity of this neoplasm in other areas of the skin.

In view of the lymphatic distribution it seems worth while to break down the quadrants of the region of the external auditory meatus and note the cures per quadrant in order to appreciate better the significance of quadrant location of the tumor area involved

TABLE V — QUADRANT LOCATION

Quadrant	No. pts	5 years	7 years	10 years
1	1	0	0	0
3	4	2	1	0
4	2	1	0	0
5	28	12	8	6
1,2	5	1	0	0
1,4	14	8	6	4
2,3	13	5	4	2
3,4	11	5	3	2
1,4,5	1	0	0	0
3,4,5	1	0	0	0
1,2,3,4	4	1	0	0



This demonstrates diagramatically the quadrant distribution used and the gross quadrant occupancy of the lesions It is evident that not enough cases of tumor in any one quadrant survived to suggest that quadrant location is of any great significance

Could it be possible that more cures were obtained in this series when the surgery was done by the otologist rather than the general surgeon? One would expect a difference in the end-results on the basis of the special training of the otologist in this area Our statistics did not bear out my clinical impression that there might be a great difference, however, these statistics do not tell the whole story Some of these cases had had previous local surgery or radiation, and many had had prolonged medical local treatment prior to reaching the otologic surgeon In some cases there was a lapse of two years which may account for some of the poor showing by the otologists Many skilled otologic and general surgeons are not so well oriented in cancer problems as those who have special interests in this field Many of these 88 cases were treated by surgeons who lacked special orientation in cancer problems The phrase "en bloc" in cancer surgery demands the most meticulous surgical technique in spite of the anatomical difficulties encountered

Table VI demonstrates the survival rates in the patients treated by the general surgeon as well as by the otologist.

TABLE VI — SURVIVAL RATE — GENERAL SURGEON AND OTOLOGIST

General surgeon	41 cases
5 year survival without obvious disease	21
7 year survival without obvious disease	13
10 year survival without obvious disease	6
Otologist	26 cases
5 year survival without obvious disease	8
7 year survival without obvious disease	4
10 year survival without obvious disease	3

Has the type of surgery performed affected the end-results? It is my personal conviction that when cancer is present in the region of the external auditory meatus it should be removed *en bloc*, including the underlying periosteum and mastoid cortex, along with most of the auricle. A modified radical mastoidectomy, including most of the auricle and as much bone tissue *en bloc* as possible, would seem to offer the patient the best possible chance for cure More of this type of surgery has been done within the past five years. The efficacy of this approach is not proven in this next table, mainly because of the lack of a sufficient number of cases so treated over a long enough period of time. In view of the high rate of failures more radical *en bloc* surgery becomes imperative

TABLE VII — TYPE OF TREATMENT

Mastoid operation	18*
5 year survival without obvious disease	2
7 year survival without obvious disease	1
10 year survival without obvious disease	0
Local Excision	49
5 year survival without obvious disease	27
7 year survival without obvious disease	16
10 year survival without obvious disease	9
Treated by X ray or radium	21
10 year survival without obvious disease	5

Six of these have been done within the last 5 years, so cannot be included in 5 year survival one died of unrelated disease.

The poor results obtained by surgery including mastoidectomy in past years must be interpreted in the light of the following chart (see Table VIII)

Only four of these 18 cases had had prior attempt at removal of the lesion by surgery or radiation, in many patients the disease had gone unrecognized for several years. Many came to the otologist long after the onset of the disease because of the failure of early diagnosis. Most of the mastoid surgery undertaken then was not *en bloc*, and although this type of procedure was adequate for infection, it was not sufficiently effective for the treatment of cancer

The high rate of failures leads me to suspect that more radical surgery during the first procedure might reduce that figure immeasurably It has always been felt that the first operation gives the patient the best chance for cure. The need for secondary operating because of recurrence has usually meant a much poorer prognosis This fact was borne out in the survivors in this series Very few survivors had more than one operation

TABLE VIII — THE 18 MASTOID CASES

	Previous Treatment	Survival after Operation	Pathology	Location	Size
1	Treated for otitis (4 yrs)	8 months	Cylindroma	5	2.0
2	X-ray and cautery (4 yrs)	5½ years	Basal Cell	1,4	4.0
3	2 local excisions	1 yr, 7 months	Ep Ca III	5	4.0
4	Treated for furunculosis (1 yr)	1 yr, 1 month	Ep Ca I	5	1.0
5 *	Treated for eczema ("for years")	2½ yrs (living without disease)	Ep Ca II	5	2.0
6 *	None	3 yrs, 2 months (living without disease)	Ep Ca I	5	0.4
7	Biopsy only	6 months (died ca stomach)	Ep Ca III	2,3	0.5
8 *	Biopsy only	3 yrs, 1 month (living without disease)	Ep Ca I	5	1.0
9 *	None	2½ yrs (living without disease)	Ep Ca I	5	0.6
10	None	1 yr, 4 months	Adenocarcinoma	5	2.0
11 *	Penicillin only	2 yrs, 2 months (living without disease)	Ep Ca III	2,3	4.0
12	Treated for eczema	1½ yrs	Ep Ca III	5	0.5
13	"drops"	1 yr, 1 month	Ep Ca I	5	1.0
14 *	None	1 yr, 3 months (living without disease)	Cylindroma	1,2,3,4	3.0
15	"treated by L M D" (nature not stated)	7 yrs, 4 months (living without disease)	Basal Cell	5	1.0
16	Biopsy only	1 yr, 4 months	Basal Cell	5	2.0
17	2 excisions	3 yrs, 10 months	Basal Cell	5	2.0
18	2 excisions and X-ray	6 yrs	Basal Cell	1,4	2.0

* Treated within past 5 years

Note All patients (except those designated as living without disease died with disease in time specified under Survival after Operation The only exception is No 7 who died of unrelated cancer of stomach six months after mastoidectomy

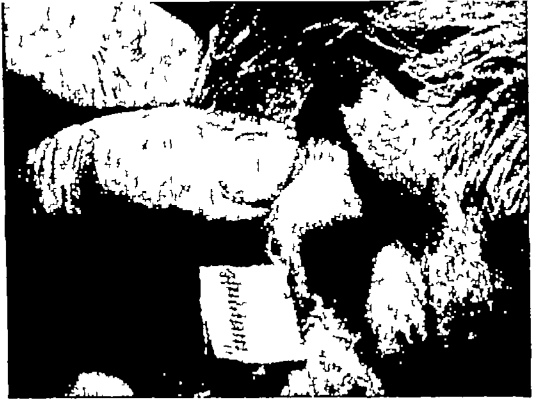


Fig 3

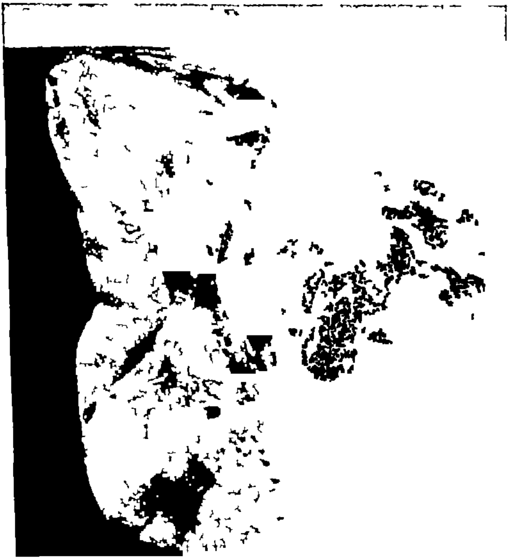


Fig 4

X-ray therapy shows a much higher number of survivors than might have been expected, however, X-radiation in an area of bone and cartilage is fraught with danger because of the possibility of radiation necrosis with its attending intense suffering, and it is often difficult to determine clinically, or by X-ray study, whether periosteum, perichondrium, cartilage or bone is involved Since the actual extent of the disease cannot

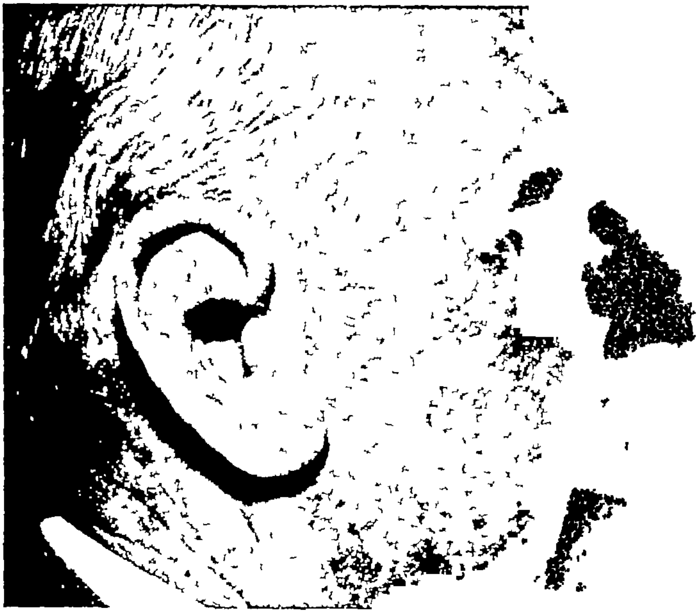


Fig 5

always be determined, wide *en bloc* surgery, including most of the mastoid process and most of the auricle, offers the best chance for complete eradication of the disease

An example of the type of lesion with which our recommended therapy is concerned is shown in Figs 3 and 4

This patient, E M, with a basal cell carcinoma within 1 centimeter of the external auditory meatus, had been treated prior to surgery unsuccessfully with two separate courses of X-ray therapy Our surgery included most of the auricle and a resection of the mastoid cortex including skin and periosteum of the external auditory canal *en bloc,* followed by piecemeal removal of most of the mastoid and then skin grafts His prosthesis on patient in Fig 5, made by Dr Henry Carney, an oral surgeon of Boston, has been most satisfactory to the patient It is made of pliable plastic material and can be worn in a shower and handled fairly vigorously without disturbing its status quo

CONCLUSION

Because of the many factors involved in this statistical study and the number of variants which could influence the significance of these factors, the conclusions I have reached may not be authentically established statistically, however, it can be stated that cancer of the auricle located within 1 centimeter of the external auditory meatus is a serious disease in spite of its histologic description, size, or quadrant location. It should be treated by radical surgery which should include removal of most of the auricle and the underlying mastoid cortex *en bloc,* and modified radical mastoidectomy in chosen cases.

Although it is true that some may be cured with X-radiation or local excision it is usually not possible to determine the true extent of the disease. For this reason the best possible procedure that can be performed as the first operation should be the treatment of choice. This may seem radical esthetically because of the removal of most of the auricle, but it is not at all radical when one considers the high rate of failures This more extensive surgery is essential to increase the present poor 10 year survival rate of 15 8 per cent to a level consistent with results obtained from treatment of cancer of the skin elsewhere on the body

HEADACHE, SINUSITIS, AND MOTHER GOOSE*†

JAMES T KING, M D,

Atlanta, Ga

> " *And when the child was grown, it fell on a day, that he went out to his father to the reapers And he said unto his father, My head, my head And he said to his servant carry him to his mother And when he had taken him, and brought him to his mother, he sat on her knees till noon, and then died* " (II KINGS *4 18-20)*

Anyone making a talk on how to cure headache by treating the nasal accessory sinuses could well take his text from II Kings, fourth chapter, 19th verse, using these four words—"My head, my head" This passage would apply not only to the patient but to the physician treating the patient as well

In my experience with headache and sinusitis I have been impressed, not by how many headaches are caused by sinus disease, but how few In the other branches of medicine, and among the public as well, sinus disease has always been regarded as a common cause of headache In my locale, this impression still persists As we all know, the causes of headache are almost innumerable, sinusitis is only one of them To illustrate this point I have taken from my files the records of 460 consecutive patients (1948-1951), whose chief complaint was headache and in whom the presence of sinusitis was either suspected or assumed I have analyzed and grouped these patients according to the cause of their symptoms

1 *Nothing Group*—173 cases, or 38 per cent This, my largest class, composes what I have chosen to call the "nothing" group In these cases there was nothing about the history or clinical examination that permitted the diagnosis of any disease or syndrome Often there was nothing more apparent

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* Read at the meeting of the Southern Section American Laryngological Rhinological and Otological Society Inc Charlottesville Va January [illegible] 1955

† From the Department of Otolaryngology Emory University School of Medicine

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than that the patient was having financial difficulties Sometimes husband and wife were fighting, others merely had hangovers

2 *Neuralgia Group*—123 cases, or 27 per cent In the second largest group are those cases with neuralgia of one or more divisions of the Vth Cranial Nerve This group did not differ greatly from the first group, as the same strong psychosomatic factor was present, however, these patients did present some reason for the suspicion of sinusitis When the frontal nerve was involved, the pain and tenderness of frontal sinusitis was to a certain extent simulated, and when the maxillary nerve was involved, the pain and tenderness of maxillary sinusitis was partially imitated

3 *General Systemic Group*—80 cases, or 17 per cent. These patients were shown to have such things as allergy, colds, influenza, or hypertension as a cause of their headache.

4 *Vascular Group*—33 cases, or 7 per cent. Twenty-two cases of migraine and 11 of histamine cephalgia comprised this group In compiling these figures, I was somewhat surprised to find that these two disorders contributed such a small percentage to the total number

5 *Intracranial Disease Group*—19 cases or 4 per cent. These included head injury in 11 cases, cerebral hemorrhage in three cases, brain tumor in two cases and meningitis in two cases The nineteenth patient turned out to have multiple sclerosis as a presumable cause of her headache.

6 *Sinusitis Group*—32 cases, or 7 per cent. You will note that, contrary to common belief, sinusitis provided the second smallest group—only the intracranial diseases provided fewer headaches Out of every 14 patients in whom the headache was thought to come from the sinuses, only one was actually proven to have sinusitis

These six groups compose the entire 460 cases, however, this classification could easily be changed to include yet another group This group would be composed of those patients with chronic headache, who go from one doctor to another receiving various treatments but never a cure, and who have been examined repeatedly and no real pathology has been found In treating these patients in the early part of this series, my headache was as severe as theirs, since I failed to give them any permanent relief

Sometimes, when I was enthusiastic about a certain treatment, the patient seemed benefited—possibly by the treatment, more probably by my enthusiasm As enthusiasm waned, so did the beneficial effect I also noted than on several occasions when I gave the patient a drug he had never received before, he would be helped by it initially Almost always the headache would return, and when it did this particular drug was no longer helpful Finally, there were those patients whom I thought that I had cured, since they did not return for further treatment My therapeutic superiority complex was converted to an inferior status when I learned that they had only left me for consultation with one of my colleagues Small comfort it was to learn subsequently that they had also left my colleague for someone else

I have come to the conclusion that we should do something to change the attitude of these patients toward their trouble Rather than give them any more histamine, ergot derivatives, vitamins, diathermy, argyrol packs, bloody nasal aspirations, or Epsom salt, I now merely try to impart a bit of the simplest philosophy I know, that of Mother Goose

For every malady under the sun
There is a cure or there is none
If there be one try to find it
If there be none never mind it

If we can get these particular patients to heed this rhyme it will help them more than the specific therapy presently available, unless we have the divine healing power of the prophet Elisha, who restored to life the child who died after crying, "My head, my head"

384 Peachtree Street, N E

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The Department of Otolaryngology, University of Illinois College of Medicine, announces its Annual Assembly of Otolaryngology from September 19 through October 1, 1955 This Assembly will consist of two parts

Part I — September 19 through September 24, 1955, will be devoted to surgical anatomy of the head and neck, fundamental principles of neck surgery and histopathology of the ear nose and throat. This week will be under the personal direction of Maurice F Snitman, M D

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The following ophthalmologists will be on the program Dr E W D Norton of New York, Dr Frank Carroll of New York and Dr William B Clark of New Orleans

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THE DEVELOPMENT OF THE EPITHELIUM OF THE LARYNX [*][†]

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What type of cell composes the mucous membrane of the larynx? Where is the epithelium squamous? Where is it ciliated? Does squamous epithelium occur in the areas of the larynx in which it is present because of a functional or pathological transition, or does it begin to differentiate in the embryo as part of an orderly process of development? These questions have interested and troubled every laryngologist Investigation of present day histology textbooks reveals a considerable difference of opinion on the problem

In the 1934 edition of his book Cowdry[3] stated that the upper part of the laryngeal vestibule is lined with stratified squamous epithelium, the lower part ciliated, over the vocal cords there is again squamous epithelium and again ciliated epithelium in the trachea.

Ten years later in a new edition of his book Cowdry[4] says only that the "mucous membrane resembles that of the pharynx." Maximow and Bloom[18] add nothing to the first description of Cowdry Sometimes the description of the laryngeal epithelium is vague, *e g* Sir E Sharper-Schafer[20] states that over the true cords and epiglottis "as well as here

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and there in the part of the larynx just above the glottis, stratified epithelium is found"

Bailey's[1] textbook tells little more "The wall of the aperture of the larynx, including the epiglottis down nearly as far as its tubercle or cushion, is lined by stratified squamous epithelium This is succeeded by the pseudostratified ciliated columnar type which lines the remainder of the laryngeal wall except for the vocal folds, which is of the stratified squamous variety"

In 1936 Bremer[2] wrote a more accurate and complete description of the laryngeal epithelium "The mucous membrane of the larynx is a continuation of that of the pharynx " "In most places the epithelium appears to be stratified, the top layer being either cuboidal or columnar It may be pseudo-stratified " "A stratified epithelium with squamous nonciliated outer cells is found on the vocal folds (true vocal cords), on the anterior surface of the arytenoid cartilages, and on the laryngeal surface of the epiglottis The distribution of the two sorts of epithelium above the vocal folds is subject to individual variation The squamous epithelium often occurs in islands and is said to replace the ciliated after local infectious desquamation" The last sentence is particularly worthy of study and will be referred to again

More recently Ham[10] wrote another accurate description of the epithelium of the larynx "The epithelium of the mucous membrane of the larynx varies in relation to the function performed by its different parts That covering the true vocal cords, which are subjected to considerable wear and tear, is of the stratified squamous nonkeratinizing type All the epithelium lining the larynx below the true vocal cords is of pseudostratified columnar ciliated type with goblet cells Most of that lining the larynx above the vocal cords is also of this type although patches of stratified squamous nonkeratinizing epithelium may be present in some sites"

Greep's[9] histology, published in 1954, also subscribes to the function theory and speaks of stratified squamous epithelium on the upper half of the epiglottis, on its posterior surface, on the arytenoid cartilages and on the vocal cords "These are all exposed surfaces that are subject to some wear and tear"

Not all descriptions are completely accurate In Jordan's[15] textbook we read that "The upper portion of the larynx, including the greater part of the epiglottis as far as the false vocal cords, is lined with stratified squamous epithelium which is continuous with that of the pharynx"

Interest in the histology of the laryngeal mucosa is not new The mucosal covering of the larynx was first mentioned in the writings of Galen[7] (131-201 A.D) He was familiar with the ability of the membrane to secrete mucous

With improvement of the microscope Jacob Henle,[12] a professor of anatomy at Zurich proved in 1838, that the larynx had an epithelial covering which was ciliated It remained for the period of the last two decades of the 19th Century for detailed studies of the laryngeal epithelium

It is not until 1885 that an adequate description of the histology of the larynx can be found Tourneux[21] determined that the free margin of the vocal cord was composed of stratified epithelium and that the rest of the adjacent area was covered by ciliated epithelium. In 1889 and 1890 there raged a controversy over whether the squamous epithelium of the larynx was the result of gradual differentiation from the embryo or whether islands of squamous epithelium appeared because of functional or pathological change The two protagonists were A A Kanthack[17] and Rudi Heymann[11]

Kanthack was an Englishman working at the Pathological Institute in Berlin, and writing in German. He was a protege of Virchow His treatise on the histology of the laryngeal mucosa is truly a fine detailed work of three parts totaling 47 pages It merits being reprinted in English today

Kanthack described in the half-term fetus a ciliary epithelium and a stratified pavement or squamous epithelium, which at that stage had rather a cuboidal structure The ciliated epithelium was found over a larger area of the fetal larynx than is the case in the adult. It was present on the entire laryngeal surface of the epiglottis and extended to the vocal cords Since the ventricle was developed at this stage it was also examined and found to be lined with "beautiful ciliated epithelium"

Kanthack endeavors to differentiate between what he calls "Pflaster" epithelium and "Platten" epithelium as two varieties of squamous lining I have translated the "Pflaster" as pavement epithelium and the "Platten" as lamellar epithelium I have consulted with many German scholars and referred to several German histology books, including Stohr's Lehrbuch der Histologie[22] and can find this distinction nowhere else

By definition, however, Kanthack describes as "Pflaster," or pavement, epithelium that in which the cells fit together in a cuboidal or mosaic fashion, whereas in "Platten," or lamellar, epithelium the uppermost layers are distinctly flattened but not necessarily cornified The area of the half-term fetal larynx which is covered with cuboid, or pavement, epithelium is only the true cord area Kanthack states categorically that this epithelium "is found nowhere else." The entire *pars respiratoria* is covered with ciliated epithelium In contrast with this pavement, or "Pflaster," epithelium that of the adult vocal cord is stratified lamellar or squamous epithelium (Platten), in which the upper layers often show distinct cornification

Because of the anatomical arrangement of the vocal cord and the ventricle in the embryo, a small portion of the entrance of the ventricle is also covered with cuboidal epithelium The transition from ciliated to cuboidal epithelium is abrupt superiorly, but may be more gradual below the cord No papillae can be found in the fetal vocal cord Kanthack states further that "it is doubtful, however, whether under normal conditions papillae are found in the adult" This statement my own studies and photomicrographs disprove

In the newborn, Kanthack found the area of pavement epithelium very small as compared with the adult It was a larger area, however, than that found in the half-term fetus He described the pavement epithelium of the oral pharynx as reaching the tip of the epiglottis, and in some cases even extending down over the laryngeal surface Usually the entire laryngeal surface of the epiglottis is covered with tall ciliated epithelium which extends over the false cords and down to the true cords The true cords are covered with pavement epithelium at the anterior commissure It is fairly high, and gradually becomes lower towards the posterior edge of the cord It extends to the region of the processus vocalis As soon as it leaves the arytenoid the pavement epithelium ends and ciliated epithelium begins and even covers the area of the posterior commissure Although the pavement epithelium becomes lower from anterior to posterior, on the arytenoid inner surface it again becomes high, and is higher than anywhere else

Heymann[14] in contrast to Kanthack described scattered islands of squamous epithelium in the larynx He considered them to be normal occurrences and believed that he could explain the situation on the basis of the embryonic history of the organism. Since the larynx lies, so to speak, at the junction of the airway lined with cylindrical epithelium and of the part of the tract lined with squamous epithelium an intermingling of both types might occur, furthermore, Heymann subscribed to the demonstration of Ganghotner[3] that the larynx developed from two parts—one belonging to the trachea the other the base of the tongue He also described transitional forms between ciliated cylindrical epithelium and the pavement epithelium

Kanthack felt that the islands of squamous epithelium described by Heymann were not physiological since they could not be found in the embryo The islands of Heymann, occurring in the midst of ciliated epithelium, were due to pathological metaplasia, said Kanthack He examined the larynges of two children who died during the first year of life and found the entire mucosa up to the lower margin of the true cords covered with pavement epithelium and even found a similar change on the posterior surface of the epiglottis

Further microscopic study of these larynges revealed evidences of inflammation, such as dilated vessels and leukocytic infiltration beneath the surface epithelium and between the muscle fibers Kanthack compared the epithelial metaplasia in the larynx to that described in nasal polyps and in the mucous membrane of the stomach bowel, gallbladder uterus urethra, trachea, and bronchi

Kanthack was also able to demonstrate microscopically that in both syphilis and tuberculosis of the larynx so much squamous metaplasia sometimes occurred that the entire larynx became covered with a tough pavement epithelium It was probably on the basis of these studies that Bremer in his textbook noted, as I indicated above, that the "squamous epithelium is said to replace the ciliated after local infectious desquamation "

Many workers such as Semon,[10] Frankel,[6] and Kallius[16] added further embryo and adult larynx studies, but not until 1898 when Doctor P Heymann[13] wrote a scholarly monograph on the histology of the mucosa of the larynx were any appreciable additions made to the understanding of the human laryngeal epithelium Doctor Heymann wrote that the thickness of the mucosa was variable, not only from individual to individual but from point to point, therefore, the various numerical diameters given by Henle[5c] and Luschka[5e] and others could have no very accurate significance

Heymann also described the two completely different types of epithelium the ciliated cylindrical epithelium and the stratified squamous epithelium Since he found the layers of ciliated epithelium not clearly differentiated, he felt that the studies of Frankenhauser[5b] and others assuming the presence of two layers, and of Dolkowski[5a] and Kolliker[d] assuming three layers could both be correct in different instances Heymann further differentiated a deep layer of epithelium resting on a basement membrane formed of somewhat cuboidal shaped cells with large, round or oval nuclei and an upper layer of epithelium formed by ciliated cells interspersed with goblet cells These latter were present in exceedingly variable numbers in five specimens

It was noted that the length of the ciliated cells was variable, and that some of them probably did not reach to the basement membrane, or basement cell layer The goblet cells were considered to be derived from ciliated cells In the stratified squamous epithelium Heymann found that the deepest layer was very similar to the layer of basal cells of the ciliated epithelium This basal layer was continuous with that of the basal layer of the ciliated epithelium, although the cells were slightly more cylindrical The thickness of the stratified squamous epithelium was also variable and depended upon the number of layers of the cells between the basement membrane and the more flattened surface cells

Heymann further discusses the character of the squamous epithelium of the larynx and confirms the presence of papillae as the result of sections made in more than 70 human larynges The papillae were parallel to the free border of the vocal cord and were not deeply indented as they normally are in the skin As Heymann says, "They were not digit like but trestle-like" To establish that these papillae were not pathologic formations as Kanthack and others maintained, Heymann described them in the larynx of the newborn, and Tourneux[23] described them in the larynx of an eight-day old child

Heymann maintained that the trestle-like arrangement of the papillae on the vocal cords probably had a certain relationship to the function of the cords "The stresses which befall the vocal cord in the course of its normal function are applied in general in a direction perpendicular to the long axis of the edges of the vocal cords The longitudinal arrangement of the trestle-like papillae which serve as an anchoring and strengthening apparatus can best withstand the stresses applied in this direction"

From about 1910 onward, I could find no original study or research on the epithelium of the larynx in the human with the exception of one article by Vidoni[24] in Italian, published in 1953 This excellent study was titled "Sullo Sviluppo E Sull'istogenesi Del Labbro Vocale' (On the Development and Histogenesis of the Vocal Lips) Doctor Vidoni studied 25 fetuses ranging from the first weeks of uterine life to birth His smallest fetus was one of 48 mm which he described as from the eighth to ninth week of intrauterine life He showed an excellent series of photographs of the external and internal appearance of the larynges of many of his fetuses

Vidoni was concerned only with the vocal lips and concluded that they were evident starting from the eighth week of intrauterine life and completely formed in fetuses 400 mm long Since the study was concerned with this area alone the microscopic sections in his paper deal only with the vocal lips and do not further differentiate the varying types of epithelium in the larynx as a whole

To study further the development and ultimate appearance of the epithelium of the larynx and to attempt to arrive at some conclusion concerning the significance of the change, 25 embryo larynges were studied, ranging from 25 mm to term One each of the following crown-rump length fetuses was fixed in formalin 25 mm , 30 mm , 65 mm , 95 mm , 125 mm., 150 mm , 180 mm , and 200 mm Following dissection, these specimens were refixed in Bouin's solution for three days They were imbedded in nitrocellulose and cut serially at 10 microns* Every tenth section was then stained with hematoxylin and eosin and mounted The 25 mm. embryo was cut transversely The others were cut horizontally, coronally, from anterior to posterior For relative ages of the various crown-rump lengths given, see the table in Fig 1

EMBRYO DEVELOPMENT

Estimated age in days	C R length in mm
32	5 0
40	13 4
46	17 0
55-60	30 0

Age (in lunar months)	C R length in mm
3	55
4	100
5	150
6	200
7	230
8	265
9	300
10	335

Fig 1 GROWTH AND DEVELOPMENT OF THE EMBRYO Adapted from Hamilton Boyd & Mossman

It must be pointed out that the only accurate measurement of embryo age is a record of coitus and the menstrual history

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* The author is greatly indebted to Mrs Helen F Burn for countless hours days and months spent preparing these many sections each one so beautifully done

Fig 3 Photograph of a 75 mm Embryo Larynx. The esophagus has been excised the tongue is attached. Scale in millimeters at left.

These factors not being available, the age is estimated by measuring either the crown rump length, which I have done, or the crown heel length or the neck-rump length. The crown rump length (C R) is the measurement of the vertex of the skull to the midpoint between the apices of the buttocks

Fig 1, adapted from Hamilton, Boyd and Mossman,[11] "Human Embryology," gives C R lengths and respective ages The gross appearance of the 75 mm and 150 mm larynges is

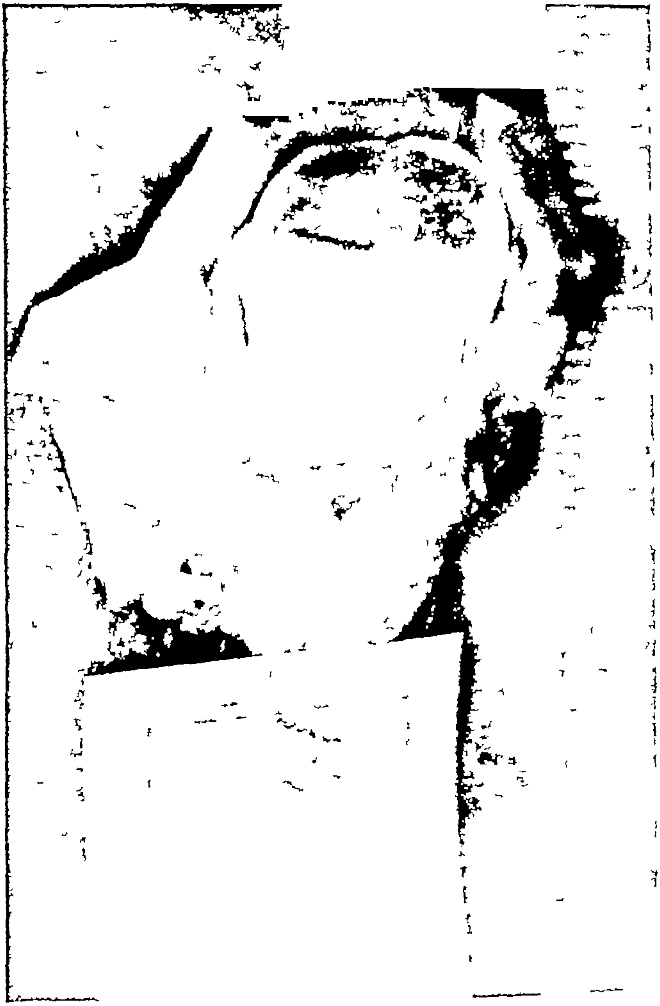

Fig 3 Photograph of a 150 mm Embryo Larynx esophagus excised, anterior tip of tongue removed Scale in millimeters at right

shown in the photographs, (see Figs 2, 3, and 4) The esophagus had been resected in each

Fig 5 is a photograph of the interior of the 150 mm larynx

The larynx was incised posteriorly and laid open To provide some comparison between the size and development of the

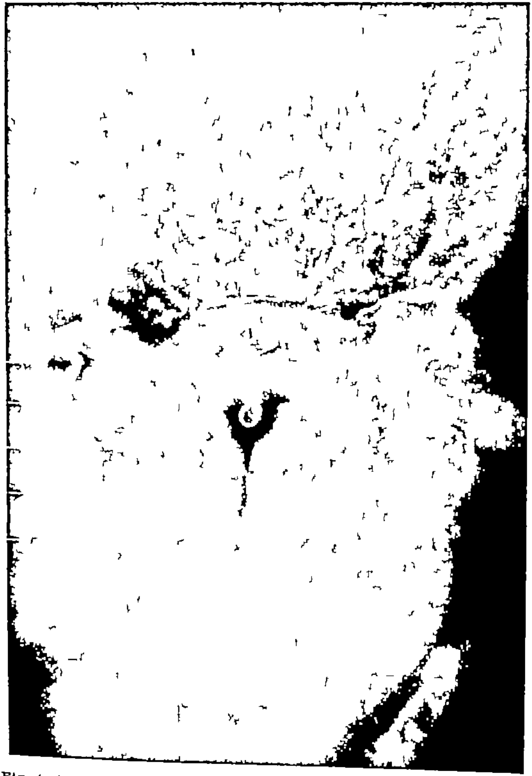

Fig 1 Photograph of a 150 mm. Embryo Larynx esophagus excised to lateral margin. Scale in millimeters at left of picture.

larynx and the size and development of the entire fetus at an almost comparable stage, Figs 6 and 7 are photographs of a

50 and a 95 mm embryo, respectively Two adult larynges were studied, dissected and sectioned

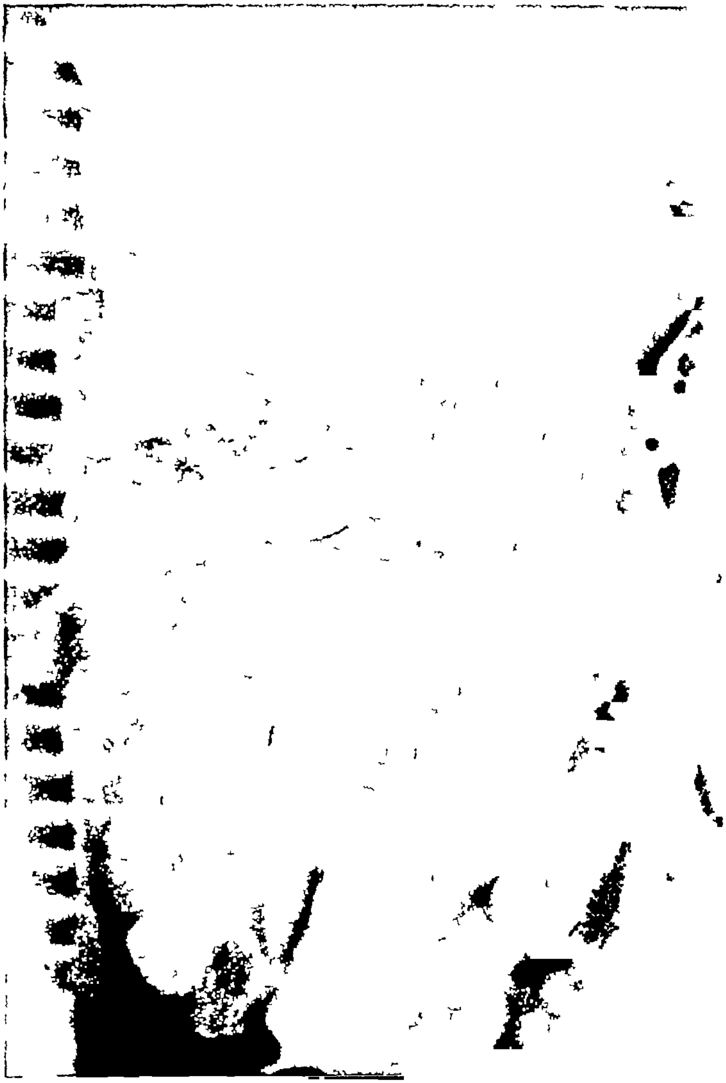

Fig 5 Photograph of 150 mm Embryo Larynx Interior esophagus excised larynx opened posteriorly Scale in millimeters at left

Fig 8 indicates the approximate area from which the section was taken of which the photomicrograph (see Fig 9) was made. The epithelium shown in the photomicrograph in Fig 9, is taken from the larynx of an 88-year-old female who died of pyelonephritis This specimen had been fixed in for-

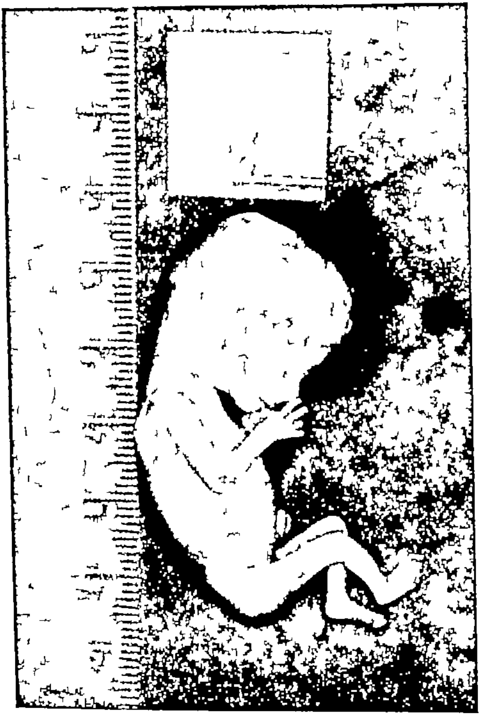

Fig 6 Photograph of a 52 mm Embryo Scale in millimeters at left.

malin and was imbedded in paraffin using the dioxane method The sections were cut at six microns and also stained with hematoxylin and eosin

In order to provide continuity of description of the changes observed in the laryngeal epithelium I would like to begin with the first appearance of the respiratory anlage and proceed through the various stages of embryonic development

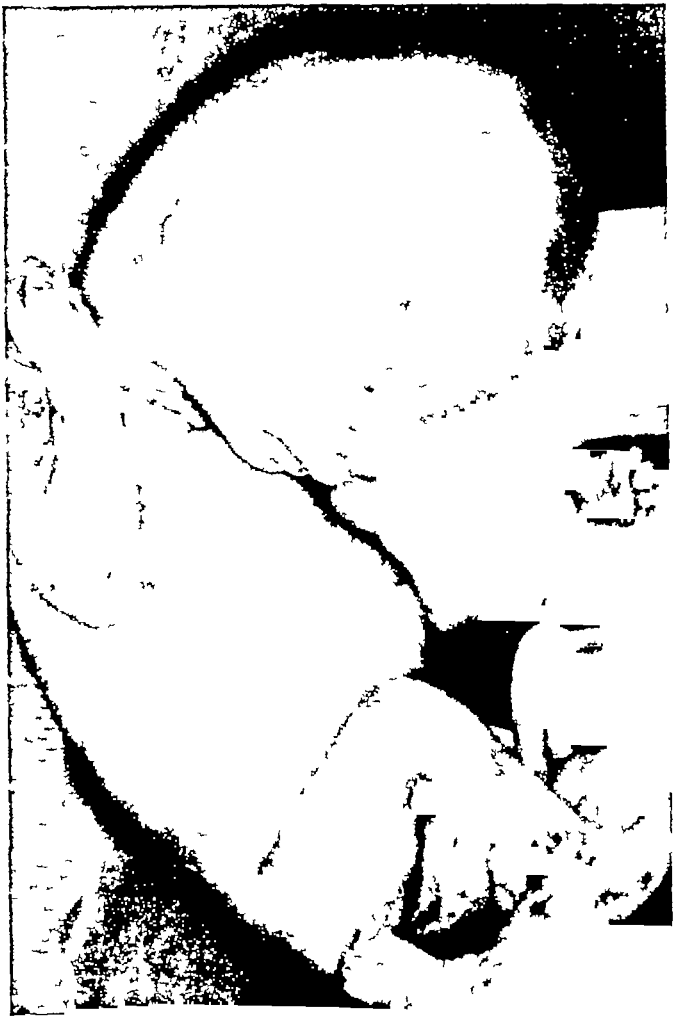

Fig 7 Photograph of a 95 mm Embryo Scale in millimeters at left.

For information concerning the stages prior to the 25 mm embryo which I have studied, I have translated the work of Soulie and Bardier [21]

The first appearance of the respiratory apparatus is in the 3 mm embryo (approximately 21 days) in the form of an evagination which looks like a vertical groove located beside the anterior wall of the cephalic portion of the foregut above the fourth branchial arch The termination of this area below is a small dilatation, or diverticulum, which is the primitive pulmonary bud This evagination or mound is called the furcula and is really the primordium of the epiglottis, which is the earliest portion of the larynx to appear, however, the epiglottis does not achieve its definitive form until approximately the fifth month of intrauterine life

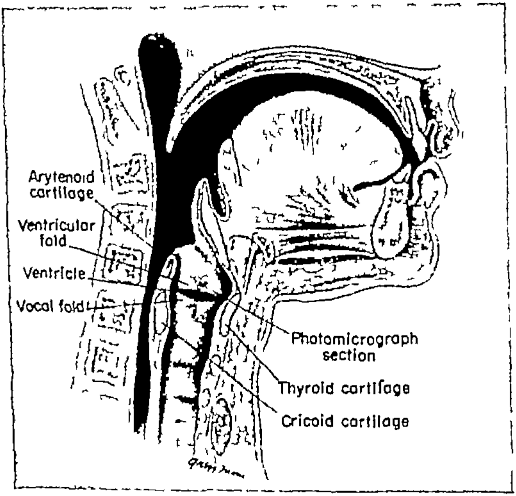

Fig. 1 Adult Larynx indicating area from which photomicrograph made

The epithelial walls which cover this above-mentioned groove are visible in the 3, 4, and 5 mm embryos They are composed of three rows of cells which are embryonic, stratified polyhedral and rest directly on the underlying mesen chyme In the 6 mm embryo the first outline of a larynx can be observed Here the respiratory groove previously described begins to close and communicates with the pharynx through a

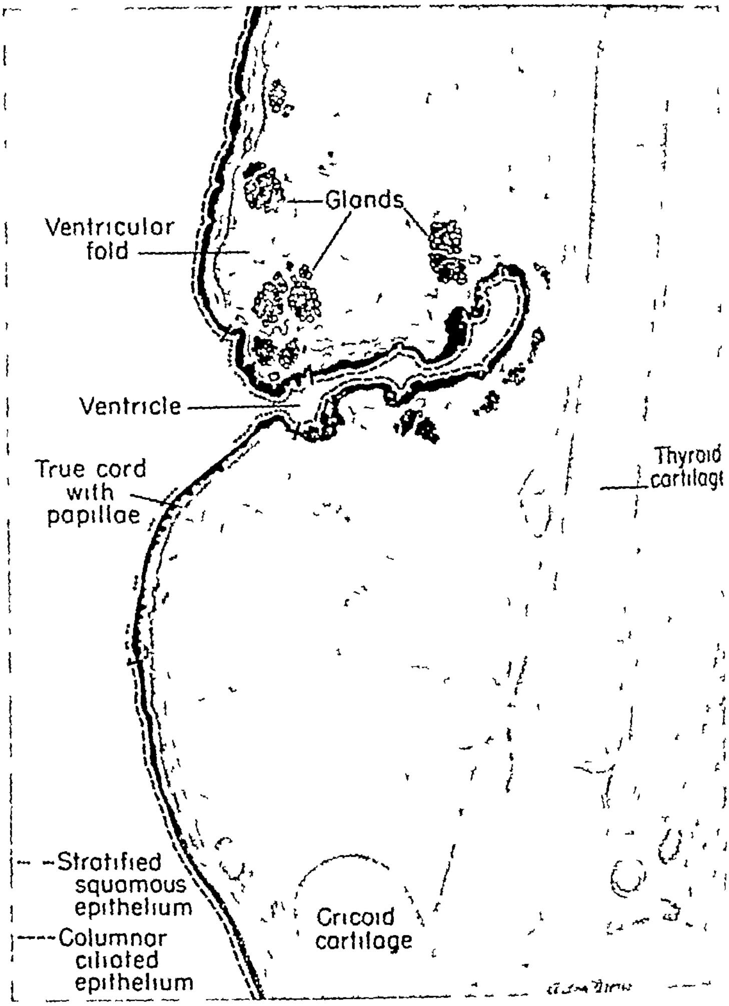

Fig 9 Drawing made from a photomicrograph of a vertical secti
the adult larynx

narrow elongated opening Two swellings appear whic
to make the closure These are rudimentary arytenoids
furcula which is now the epiglottis is joined on each s
the upper extremity of the just described arytenoid sw

by a small fold which occupies the end of the groove. Each of these folds represents the first outline of the corresponding aryteno-epiglottic fold

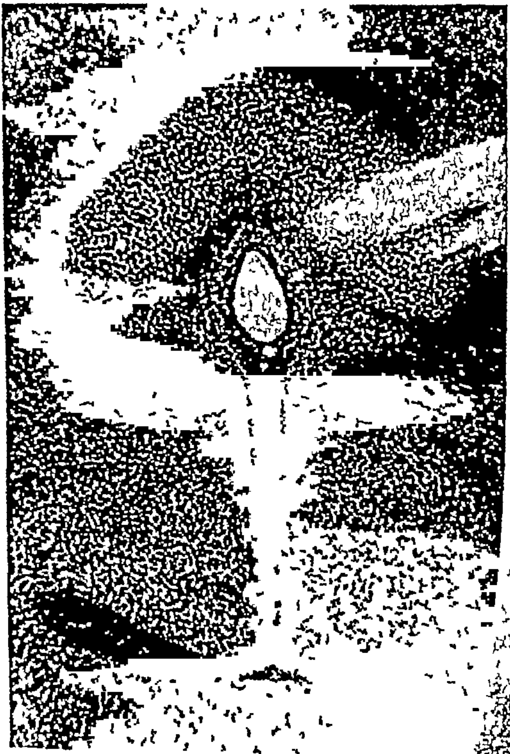

Fig 10—a. 25 mm. Embryo Larynx

Thus in the embryo through the 6 and 7 mm. stage, the laryngeal cavity is open throughout its extent. It is par tially obliterated in the 8 mm embryo by the fusion of the little primordial arytenoids and by the fusion of the respective layers of embryonic, polyhedral stratified epithelium

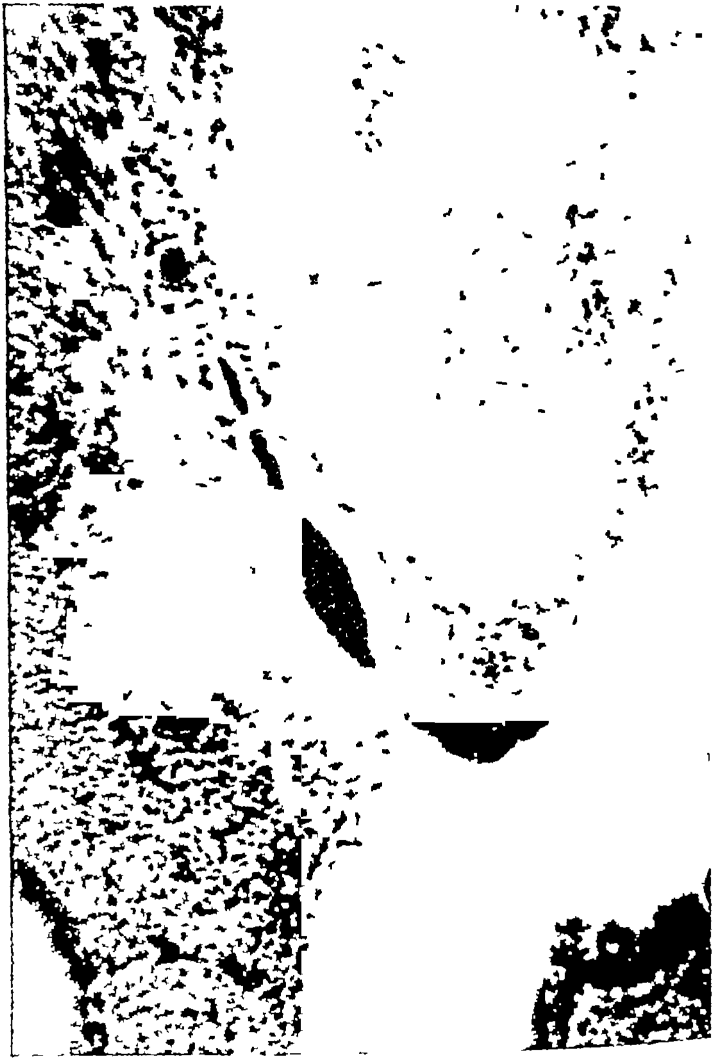

Fig 10—b 65 mm Embryo Larynx

which I have described as lining each side of the laryngeal cleft Laryngeal cartilages first begin to appear in the 19 mm (40 days) embryo The mucosa of the larynx remains the same throughout. In the 80 mm (60 to 70 days) embryo, the number of layers of cells in this embryonic, stratified epithelium increases The vocal cords begin to differentiate

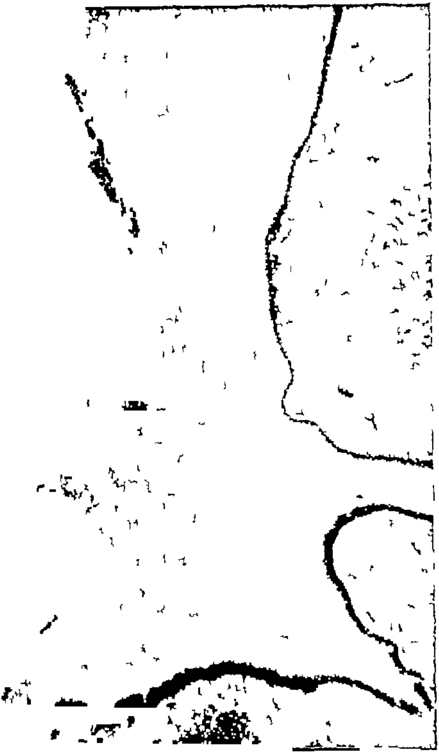

Fig. 10—c. 95 mm. Embryo Larynx.

The glottis really consists of three distinct parts at this stage, an anterior part which lies between the vocal cords and which is covered with a surface epithelium which is beginning to assume a cylindrical form, a middle part which corresponds to the area of the arytenoid cartilages, and a posterior part which is composed of the cavity of the cricoid.

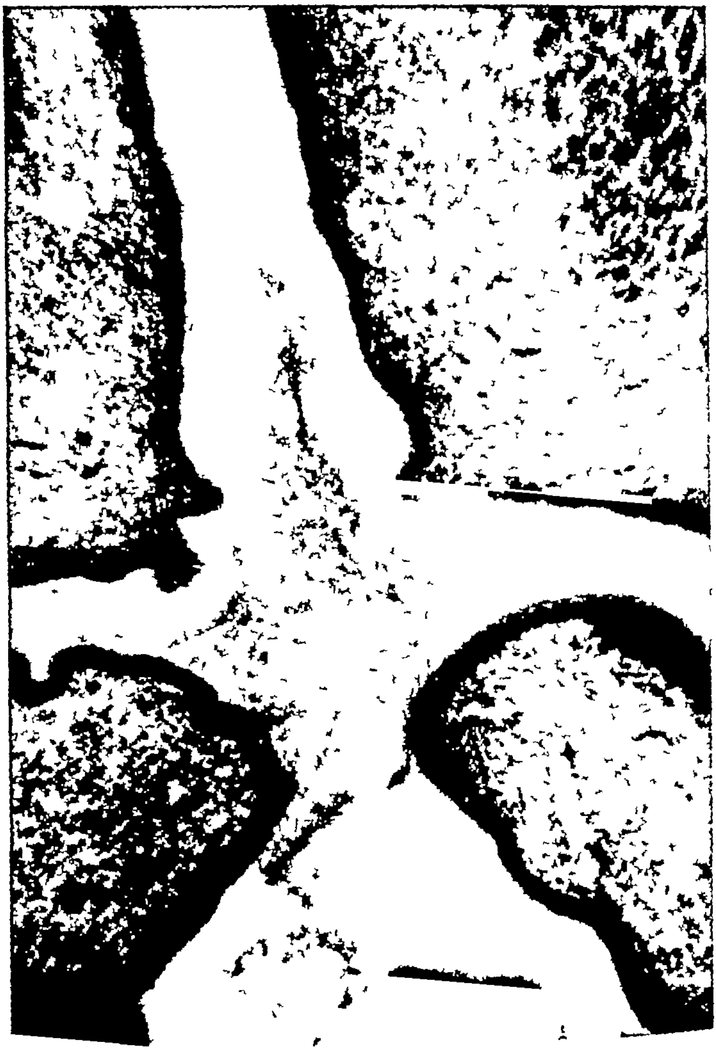

Fig 10—d 125 mm Embryo Larynx

In the inter-arytenoid space the layers of previously fused epithelium are beginning to separate, and here we still find the embryonic, polyhedral cells

Ciliated epithelium appears on the epiglottis and at the vestibule of the larynx in the 40 mm. embryo The glottic surface of the vocal cord is still lined with an epithelial layer of polyhedral cells some five- or six-cell layers thick. Beginning at about the 10th or 11th week the epithelium previously fused, begins to separate as the true vocal cords appear The larynx assumes in section somewhat the shape of a "T" with the cross bar curved and representing the base of the tongue. One area of the larynx remains fused longer than any other, that is the area which later becomes the incisura inter arytenoidea It is fused even into the 95 mm embryo (approximately 15 weeks)

The formation of the incisura and thus the separation of the epithelium occurs in approximately the 150 mm embryo (about the fifth lunar month or 20th week) At the 95 mm fetus stage the vocal cords show a rather cuboidal, somewhat embryonic epithelium, which extends into the opening of the ventricle. In the ventricle itself and above the vocal cords, the epithelium is a beautiful, ciliated variety See photomicrographs for detail (see Fig 10)

I should like to emphasize that from a study of the embryos sectioned for this study, and from the description of the embryos sectioned by Soulie and Bardier,[21] Kanthack,[17] Kallius,[16] and others, I find that the differentiation of the epithelium of the larynx is always an orderly process occurring in certain places at certain definite times The epithelium initially is an embryonic, polyhedral variety Some of it becomes columnar ciliated and the rest becomes cuboidal and then stratified squamous This is well demonstrated in the 95 and 125 mm fetuses where the epithelium is columnar or prismatic stratified ciliated in all the vestibular areas, and is stratified pavement like on the true cord and entrance to the ventricle The changes may be seen in the photomicrographs of both the 95 mm. and 125 mm embryos

The transition from one variety of epithelium to the other is rather sharp, particularly on the side of the ventricle Cilia never develops in the interarytenoid region The vocal cord itself never develops any ciliated cells In the 150 mm and 180 mm. fetuses (from about the middle of the fifth month) the stratified squamous epithelium of the vocal cord diminishes in thickness because of the desquamation of the superficial layers

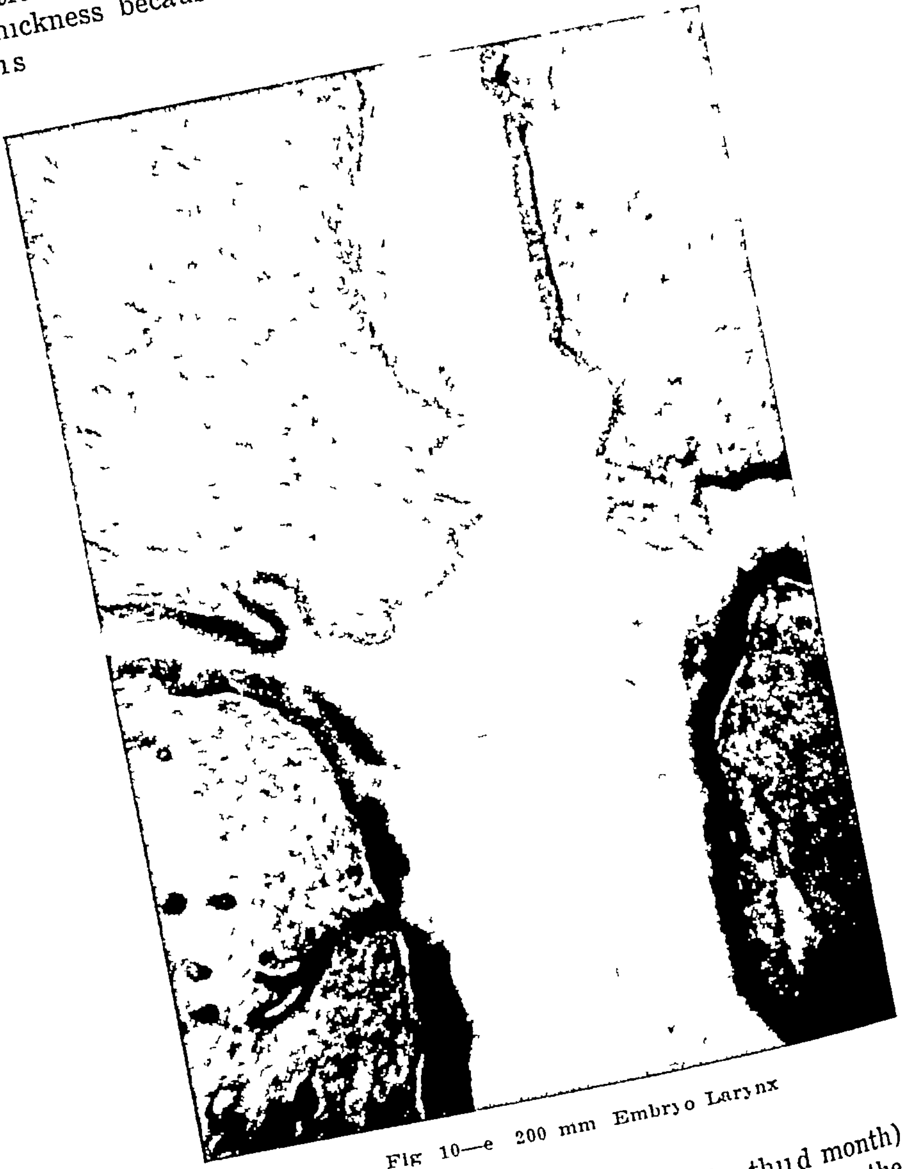

Fig 10—e 200 mm Embryo Larynx

From the time (about the middle of the third month) that the ventricles have achieved their definitive form, the false cords, which probably should be more properly called at this stage of development the ventricular bands, are lined with cylindrical, often stratified ciliated epithelium In a five-month female, described by Soulie and Bardier, this area of ciliated epithelium was still visible, whereas in a male infant of six months it had been replaced by stratified squamous epithelium

SUMMARY

The earliest epithelium of the larynx is embryonic, polyhedral, which fuses and, at about the time of the beginning of the development of the true cords, separates The embryonic epithelium of the true cords becomes cuboidal and then stratified squamous This includes the area extending into the ventricle The remainder of the larynx, with the exception of the continuation of the vocal cord into the inter-arytenoid area, becomes lined with ciliated epithelium which is columnar and pseudo-stratified.

During the first year of life, with the further development of the larynx itself and with the anatomical changes in the relationships of the true cords, ventricles and ventricular folds, the area of the ventricular folds becomes covered with a squamous epithelium comparable to that of the true cord

The problem of obtaining a good microscopic section of an adult larynx is a considerable one, because of its location in the interior of the human body and because of the difficulty fixing this particular tissue rapidly enough Few really good microscopic sections of adult laryngeal epithelium are in existence From a study of those available, and of the larynges which we sectioned (see Fig 9 drawing made from photomicrograph of the adult larynx) I believe that it can be seen that the true cord itself is covered with stratified squamous epithelium, which has small papillae

The ventricle is lined with ciliated epithelium, which varies in thickness The false cords are lined with squamous epithelium The inter-arytenoid area is lined with squamous epithelium There may also be occasional islands of squamous epithelium in the adult larynx, but I believe these are rare In general I think they result from pathological changes I like to think of the development of the epithelium which I have here outlined as being a "physiological metaplasia," as Kanthack describes it As a matter of speculation, if further progression in the metaplasia of the epithelium of the larynx is pathological, as has been demonstrated and described above in cases of syphilis and tuberculosis, it is conceivable that a continuation of this progression could result in the production of malignant change Then if one could determine what causes some individuals to continue the progressive metaplasia of their laryngeal epithelium and thus develop carcinoma, new light might be shed on this problem Recent studies have suggested the possibility of a relationship between carcinoma of the breast and endocrine inhibitor substances It is not inconceivable that in the normal individual some such mechanism controls the metaplasia of the epithelium of his larynx

CONCLUSION

From a review of the literature and a personal study of 25 embryos and two adult larynges with serial sections of eight of the embryos and both of the adults, it has been demonstrated that the epithelium of the larynx differentiates in a definite pattern throughout embryonic life to achieve its adult appearance This is physiological metaplasia Absence or deficiency of an inhibitor substance which prevents metaplasia from progressing beyond this physiological stage in normal individuals, could be a factor in the development of laryngeal carcinoma This merits further investigation

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STRESS AND DISEASE*

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It is impossible to touch upon all aspects of this topic in a single lecture. The literature on stress and the adaptive hormones, which was first analyzed in the form of an extensive monograph in 1950,[1] is now growing at the rate of four to six thousand publications per annum. A survey of these, will be found in our "Annual Reports on Stress,"[2,3,4,5] which are designed to aid the dissemination of information and the coordination of new facts in this domain.

The subject has recently been summarized in the form of seven informal illustrated lectures, which attempt to explain the theoretical background of this topic, as far as its understanding is essential for the comprehension and logical treatment of certain diseases which we consider to be primarily "diseases of adaptation."[6]

It may be opportune to take stock now after 20 years of stress-research, and present here the most fundamental facts which we have learned about the physiopathology of stress; however, for those not particularly familiar with the subject, it may be well first to give a glossary of the most common technical terms used in this field.

GLOSSARY OF TECHNICAL TERMS AND ABREVIATIONS

Stress—Non-specific deviation from the normal resting state. It is caused by function or damage and stimulates repair.

Non-specific change—Change which can be produced by many or all agents.

Specific change—Change which can be produced only by one or few agents.

G.C.—Glucocorticoid (*e.g.*, cortisone, cortisol).

M.C.—Mineralocorticoid (*e.g.*, desoxycorticosterone, aldosterone).

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A-C—Antiphlogistic corticoid (*e g* cortisone cortisol) Essentially synonymous with G-C since the antiphlogistic glucocorticoid lympholytic and catabolic activity tends to run parallel in the steroids so far examined

P C—Prophlogistic corticoid (*e g.,* desoxycorticosterone desoxocortisone) Essentially synonymous with M-C since the prophlogistic activity tends to run parallel with mineralocorticoid activity in the compounds so far examined

DCA—Desoxycorticosterone acetate or DOCA

Cortisol—Hydrocortisone Kendall s compound F

STH—Somatotrophic hormone or growth hormone of the hypophysis

MAD—17 methylΔ^{5}-androsterone-3β 17β-diol (Ordinary methylandrostenediol)

Precursors of the Stress Concept Ever since man used the word "disease" he had some, at least subconscious, inkling of the stress concept. The very fact that a single term can be used to denote a great variety of individual maladies clearly indicates that they have something in common They possess, as we would now say, some non specific features which permit us to distinguish disease from the condition of health yet, precisely because these manifestations are not characteristic of any one disease, they have received little attention in comparison, with the specific ones They were thought to be of lesser interest for, unlike the latter, they did not help to recognize the "eliciting pathogen" or lend themselves to any effective type of specific therapy

Several early investigators nevertheless have attempted to elucidate the mechanisms involved in such non-specific reactions Since our knowledge of the nervous system antedates, by far, the development of modern endocrinology it is understandable that, among the two great integrating systems of the body, the nervous and the hormonal systems the former was the first to be examined from this point of view Ricker Sparansky, Reilly, Hoff and many others have gathered important data concerning the rôle of the nervous system in such non specific reactions as fever, polymorphonuclear leucocytosis, inflammation, etc.

In the domain of what may be called "physiologic stress" W Cannon's studies helped us to understand the part played by the sympathetic nervous system and its humoral effector substances, furthermore, quite independently, a great deal of progress has been made in the study of pituitary and adrenocortical hormones by chemists, physiologists and clinicians, too numerous to mention by name

All the knowledge acquired as a result of these early investigations was indispensable for the eventual formulation of the stress-concept, whose leading motive is one of unification Additional experiments had to be performed, however, to show that the many non-specific responses of individual target organs are closely integrated and actually represent part of a single biological response—the general adaptation syndrome These investigations, which will be outlined below, made it evident that the "stress pattern" of reaction plays an integral part in the most varied physiologic, pathologic and pharmacologic phenomena

The Concept of Stress By a series of experiments on animals, it was demonstrated in 1936 that the organism responds in a *stereotypical* manner to a variety of widely different factors, such as infections, intoxications, trauma, nervous strain, heat, cold, muscular fatigue or x-irradiation The specific actions of all these agents are quite different Their only common feature is that they place the body in a state of general (systemic) stress We concluded, therefore, that the stereotypical response, which is superimposed upon all specific effects, represents the somatic manifestations of non-specific "stress" itself

What is Non-specific "Stress?" The term had long been used in physics to denote the interaction between a force and the resistance opposed to it, for instance, pressure and tension can put inanimate matter under stress The above mentioned non-specific response was thought to represent the biologic equivalent of such physical stress The term has now been quite generally accepted in this sense, not only in English but, since attempts to translate "stress" led to much confusion, also in most other languages

The Concept of the G-A-S The most outstanding manifestations of this stress-response were *adrenocortical enlargement* with histologic signs of hyperactivity, *thymicolymphatic involution* with certain concomitant changes in the blood-count (eosinopenia, lymphopenia, polynucleosis) and *gastro-intes-*

tinal ulcers, often accompanied by other manifestations of *damage or "shock"*

We were struck by the fact that, while during this reaction all the organs of the body show involutional or degenerative changes, the adrenal cortex actually seems to flourish on stress We suspected this adrenal response to play a useful part in the systemic, non specific adaptive reaction, which we visualized as a "call to arms" of the body's defense forces and named the "alarm reaction"[1]

Subsequent studies showed that the alarm reaction is but the first stage of a much more prolonged *General Adaptation Syndrome (G-A-S)* The latter comprises three distinct stages namely

1 *The Alarm Reaction* (A-R), in which adaptation has not yet been acquired

2 *The Stage of Resistance* (S R), in which adaptation is optimal

3 *The Stage of Exhaustion* (S E), in which the acquired adaptation is lost again

The Mechanism of the G-A-S In order to elucidate the kinetics of this syndrome we proceeded as follows

Rats were adrenalectomized and then exposed to stressor agents This showed us that in the absence of the adrenals, stress can no longer cause thymico-lymphatic involution or characteristic blood-count changes

When adrenalectomized rats were treated with the impure cortical extracts available at that time, it became evident that thymico-lymphatic involution and the typical blood-count changes could be produced by adrenal hormones, even in the absence of the adrenals therefore, these changes were considered to be indirect results of stress mediated by corticoids

Conversely, the gastro-intestinal ulcers and other manifestations of pure damage or shock were actually more severe in adrenalectomized than in intact animals and could be lessened by treatment with cortical extracts It was concluded that these lesions are not mediated through the adrenal, in fact, they are actually combated by an adequate adreno-cortical response to stressor agents[8]

What Stimulates Adreno-cortical Function During Stress? In the course of the next year, we found that among many surgical interventions tried, only hypophysectomy prevents adrenal response during the alarm reaction, hence, we concluded that stress stimulates the cortex through an adrenocorticotrophic hormone, now known as ACTH[10 11]

Then pure cortical steroids became available, thanks first of all to the classical investigations of Kendall and Reichstein With these, we could show that administration of *mineralo-corticoids* or *M-Cs* (such as desoxycorticosterone) produces experimental replicas of the so-called *hypertensive and inflammatory "rheumatic" diseases, notably, nephrosclerosis, hypertension, vascular lesions* (especially periarteritis nodosa and hyalin necrosis of arterioles),[12] as well as arthritic changes resembling, in acute experiments, those of rheumatic fever and, after chronic treatment, those of rheumatoid arthritis,[13] yet, even very high doses of mineralo-corticoids did not induce any noteworthy thymico-lymphatic or blood-count changes, such as were caused by cortical extracts

Significantly, exposure of animals to certain non-specific stressor agents (*e g*, cold) produced marked adreno-cortical enlargement and organ changes very similar to those elicited by the administration of mineralo-corticoids[14] Many investigators doubted that secretion of *M-Cs* could be involved in the pathogenesis of disease, since the very existence of natural, endogenous *M-Cs* was questioned Indeed, until quite recently, some of the most eminent students of the adrenal advocated the "unitarian theory," which held that the gland secretes only one corticoid, so that a derangement in the balance between antagonistic cortical hormones would be impossible This concept was definitely disproven by the isolation of *aldosterone* from both the tissue and the venous blood of the adrenals[15]

Extracts rich in *gluco-corticoids or G-Cs,* such as cortisol and cortisone on the other hand, were highly potent in causing *thymico-lymphatic* involution and in eliciting the characteristic blood-count changes of the alarm reaction They also tended to inhibit the inflammatory "rheumatic like" changes which can be elicited in animals by mineralo-corticoids Thus, in many respects, the two types of corticoid hormones antagonize each other[19]

Another interesting activity of the corticoids discovered at about this time is their singular effect upon the *central nervous system* of animals A variety of steroids among which figured both G Cs (*e g* cortisone) and M Cs (*e g* DOA) as well as other steroid hormones and hormone-metabolites (*e g*, pregnanediol pregnanedione) proved to possess the property of causing a state of great excitation and confusion followed by marked depression of all reflex activities and eventually deep anesthesia

This observation raised the question whether a pronounced increase in the activity of endogenous corticoids could be responsible for certain nervous emotional accompaniments of exposure to stress After the introduction of cortisone into clinical therapy it became evident that in man this hormone can also exert a powerful effect upon the central nervous system. In animals both G-Cs and M Cs exhibit this effect hence we shall have to watch for it as soon as patients will be treated with large doses of aldosterone

The terms "gluco-corticoids" and "mineralo-corticoids" emphasize the salient metabolic actions of these substances from a clinical point of view, however, their effects upon inflammation are perhaps of even greater interest Since the gluco corticoids inhibit inflammation, while the mineralo-corticoids enhance it, the G-Cs may appropriately be called *"antiphlogistic corticoids"* or *"A-Cs "* and the M-Cs *"prophlogistic corticoids,"* or *"P Cs"* when they are discussed with reference to their effects upon inflammation It remains to be seen, however, whether G C and A C (or M C and P C) activities necessarily run parallel in all steroid compounds, including those (like aldosterone) which have not yet been fully examined for these effects

Inflammatory granulomas especially those produced in the vicinity of joints by the local applications of irritants (*e g*, formalin, mustard powder), as well as certain allergic reactions, are likewise aggravated by P-Cs and inhibted by A-Cs Apparently, the response of the adrenal cortex is most important not only in defense against systemic stress (affecting the whole organism), but also in the manifold topical defense reactions which occur upon exposure to *local stress* (*e g*, bacterial or chemical irritants, response of a "shock organ" to an allergen)[1,14]

These findings helped to formulate the concept of the Local

Adaptation Syndrome (L-A-S) to be discussed below (see pages 508-509)

In this connection the hormone sensitivity of certain so-called "*anaphylactoid inflammatory reactions*" is of special interest Actually, our attention had first been called to a possible relationship between the adrenal cortex and inflammation by an incidental observation on rats given parenteral injections of egg white It was found that the rat is naturally hypersensitive to egg white and responds to the intraperitoneal or intravenous administration of this substance by an acute serous inflammation of the paws and snout This inflammatory response was greatly aggravated in adrenalectomized animals (presumably because they could not defend themselves by the endogenous production of A-Cs)

On the other hand, it was prevented by treatment with systemic stressors, directly in proportion to the adreno-cortical enlargement they produced (presumably, as a result of excess A-C secretion)[11] Subsequently, it could be shown that cortisone and ACTH inhibit, while certain crude anterior pituitary preparations and desoxycorticosterone aggravate this anaphylactoid type of acute inflammation[11],

Curiously, our crude *anterior pituitary extracts* also duplicated *most of the above mentioned actions of P-Cs upon the cardiovascular system, the blood-pressure, the connective tissue (inflammation) and the kidneys*[9, 10]

The hypophyseal preparations which we used were definitely corticotrophic, in that they enlarged the adrenal cortex, but they were particularly rich in the so-called "growth hormone" or *somatotrophic hormone (STH)* This made it difficult to interpret our early experiments, in which such crude extracts were used, because we were unable to distinguish clearly between the effects of ACTH and STH, however, as soon as we obtained purified ACTH, it became evident that the above mentioned pathogenic actions of the crude anterior-pituitary preparations could not be due to their ACTH content, since even the highest tolerable doses of the pure corticotrophic hormone failed to duplicate their predominant P-C effects

On the other hand, overdosage with purified STH caused cardiovascular and renal lesions, virtually identical with those previously observed in animals treated with P-Cs It was then concluded that, probably, the characteristic actions of our crude anterior-pituitary preparations were mainly due to their STH content It remains to be seen to what extent STH acts indirectly by sensitizing the peripheral tissues to P-Cs Preliminary observations suggest that the last-mentioned mechanism is more important, although both may be implicated[20] This point is not yet settled

From the internist's point of view, perhaps the most interesting role of STH in the adaptation syndrome is that it can effectively *combat catabolism and susceptibility to infections* Animals heavily overdosed with ACTH or A Cs, tend to lose a great deal of weight. Eventually they die, almost always as a result of generalized septicemia, caused by normally saprophytic micro-organisms In rats, the lung tissue appears to be singularly predisposed to such infections Under these conditions, adequate doses of STH prevent the loss of body-weight as well as the excessive microbial proliferation [1]

It remains to be seen to what extent these actions of STH will prove to be of value in the management of infections in man but experiments on rats have already demonstrated the great influence of adaptive hormones upon resistance to the human type of tuberculosis Normally the rat is virtually resistant to tuberculosis bacilli It may be rendered sensitive by ACTH or A-Cs and this sensitivity can in turn be abolished by STH [22,23]

Conditioning of Hormone Actions As work along these lines progressed it became increasingly more obvious that the activity of the hormones produced during stress depends largely upon a variety of "conditioning factors" Both the production of the "adaptive hormones" and their effect upon individual target organs proved to be greatly influenced by heredity, age previous exposure to stress the nutritional state, etc Thus, for instance the production of corticotrophic hormone by the pituitary is enhanced by a high protein diet while the action of M Cs upon most target organs is augmented by excess sodium*

Stress itself is perhaps the most effective and most common factor capable of conditioning the actions of adaptive hormones Thus systemic stress augments the antiphlogistic, lympholitic catabolic and hyperglycemic actions of A Cs while the salient effect of the adaptive hormones that of modifying the course of inflammation naturally cannot manifest itself unless some topical stressor first elicited a phlogistic response

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Ingle introduced the concept of the "permissive actions" of corticoids This term implies that the adrenal hormone does not effect a target of stress itself although it permits a stressor to act upon it furthermore allegedly the presence or absence of a permissive factor can only allow or disallow a reaction but is unable to vary its intensity

To illustrate this concept one might compare the production of light by an electric lamp to the biologic reaction and the switch to the 'permissive factor" The switch cannot produce light nor regulate the degree of its intensity but unless it is turned on the lamp will not function

Correspondingly the functional signs generally considered to be characteristics of corticoid-overproduction during stress would not result from any actual increase in corticoid secretion but from the extra adrenal actions of the stressors themselves The presence of corticoids would be necessary only in a "supporting capacity" to maintain the vitality and reactivity of tissues

Actually it is precisely in the specific and not in the non specific stress-reactions that the corticoids play a purely "permissive rôle of this type Here they are necessary only to prevent stress and collapse, thus keeping the tissues responsive For instance adrenalectomized rats will not respond to injected STH with somatic growth or to sexual stimulation with mating without a minimal maintenance corticoid treatment

These reactions are in fact not characteristic of the corticoids and could not be duplicated in the absence of the specific stimulus even with the highest doses of corticoids The characteristic functional signs of A C-overproduction which we see in the alarm reaction (*e g* atrophy of the lymphatic organs catabolism, inhibition of inflammation) are also impeded by adrenalectomy and restored even by mere maintenance doses of A Cs in the presence of stress which sensitizes or "conditions the tissues to them however *unlike specific actions these non-specific effects* can also be duplicated in the absence of any stressor if large doses of A-Cs are given (see 'Fourth Annual Report on Stress pp 78 85)

The importance of such conditioning influences is particularly striking in the regulation of stress reactions because in the final analysis they are the factors which can actually determine whether exposure to a *stressor will be met by a physiologic adaptation syndrome or cause* 'diseases of adaptation", furthermore in the latter instance these conditioning factors can even determine the selective breakdown of one or the other organ We are led to believe that differences in predisposition due to such factors might explain why the same kind of stressor can cause diverse types of 'diseases of adaptation in different individuals

Incidentally, it was only on the basis of such experiments that the mechanism through which stress effects the adrenal cortex could be clarified We noted that stressors such as 'formaldehyde' which caused marked adrenal hypertrophy in the normal but not in the hypophysectomized animal remained without effect (upon the adrenal) even if the adrenal cortex was prevented from undergoing atrophy by the administration of pituitary extract The effect of such a drug on the adrenal appears *to be an indirect one due to pituitary stimulation* [10]

The Concept of the L-A S It had long been known that many local responses to injury are non specific It had been noted for instance that a variety of 'topical stressors (burns microbes drugs) share the power of producing non specific tissue damage and/or inflammation however it is only recently that the close relationship between the systemic and local types of non specific reactions has been more clearly established

While the characteristic response of the body to systemic stress is the G-A S, characterized by manifold morphologic and functional changes throughout the organism topical stress elicits a "Local Adaptation Syndrome" (L-A S), whose principal repercussions are confined to the immediate vicinity of the eliciting injury They consist on the one hand of degeneration atrophy and necrosis on the other of inflammation hypertrophy hyperplasia and under certain conditions neoplasia.

L-A-S and G-A-S At first sight, there appears to be no striking similarity between the systemic and the local reaction type A patient in traumatic shock furnishes a characteristic example of the G-A-S and, in particular, of its earliest stage the "shock phase' of the general alarm reaction An abscess, formed around a splinter of wood represents a typical example of the L-A-S and, in particular, of its 'stage of resistance," during which the defensive inflammatory phenomena predominate On the surface these two instances of disease reveal no striking similarities, and yet more careful study shows them to be closely related

The experimental observations which led us to these conclusions have been described elsewhere[illegible] Let us restate here however that among other things the G-A S and the L-A S are thought to be interrelated because

1 Both are non-specific reactions comprising damage and defense

2 Both are triphasic with typical signs of "crossed resistance (or depending upon the stressors used crossed sensitization") during the second stage

3 Both are singularly sensitive to the so-called adaptive hormones" (ACTH STH corticoids)

4 If the two reactions develop simultaneously in the same individual they greatly influence one another that is systemic stress markedly alters tissue-reactivity to local stress and vice-versa

The Concept of the Diseases of Adaptation Thus we arrived at the conclusion that the pathogenicity of many systemic and local stressor agents depends largely upon the function of the hypophysis-adreno-cortical system The latter may either enhance or inhibit the body's defense reactions against stressors We think that derailments of this adaptive mechanism are the principal factors in the production of certain maladies which we consider, therefore, to be essentially *Diseases of Adaptation*

It must be kept in mind that such diseases of adaptation do not necessarily become manifest during exposure to stress This is clearly demonstrated by the observation that temporary overdosage with desoxycorticosterone can initiate a self sustaining hypertension, which eventually leads to death, long after hormone administration has been discontinued Here, we speak of "metacorticoid" lesions The possibility that a temporary excess of endogenous aldosterone could induce similar delayed maladies deserves serious consideration

Among the derailments of the G-A-S which may cause disease, the following are particularly important

1 An *absolute excess or deficiency* in the amount of adaptive hormones (*e g* , corticoids, ACTH, STH) produced during stress

2 An absolute excess or deficiency in the amount of adaptive hormones *retained (or "fixed")* by their peripheral target organs during stress

3 A disproportion in the relative secretion (or fixation) during stress, of various antagonistic adaptive hormones (*e g* , of ACTH and A-Cs, on the one hand, and of STH and P-Cs, on the other)

4 Production by stress of metabolic derangements, which abnormally alter the *target organ's response* to adaptive hormones (through the phenomenon of "conditioning")

5 Finally, we must not forget that although the hypophysis-adrenal mechanism plays a prominent rôle in the G-A-S, *other organs* which participate in the latter (*e g* , nervous system, liver, kidney) may also respond abnormally and become the cause of disease during adaptation to stress

Summary of Observations To summarize, we might say that all agents which act upon the body or any of its parts exert dual effects

1. Specific actions, with which we are not concerned in this review except insofar as they modify the non specific actions of the same agents

2 *Non specific or stressor effects* whose principal pathways (as far as we know them today) are illustrated in Fig 1

The stressor acts upon the target (the body or some part of it) directly (thick arrow) and indirectly through the pituitary and adrenal

Through some *unknown pathway* (labelled by a question mark) the "first mediator' travels from the directly injured target area to the *anterior pituitary* It notifies the latter that a condition of stress exists and thus induces it to discharge ACTH

It is quite possible that this 'first mediator" of hormonal defense is not always the same In some instances it may be an adrenaline discharge in others a liberation of histamine-like toxic tissue *metabolites* a nervous impulse or even a sudden deficiency in some vitally important body constituent (such as glucose or an enzyme)

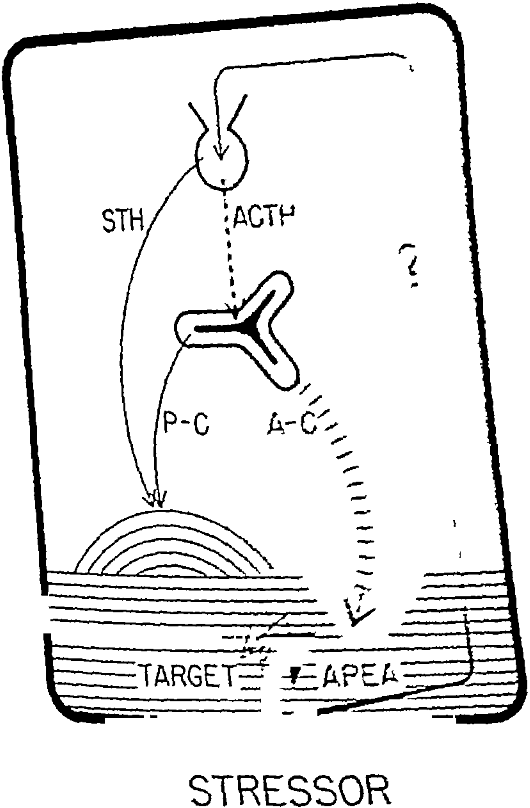

Fig 1. (after Selye)

ACTH stimulates the *adrenal cortex* to discharge corticoids. Some of these, the *prophlogistic corticoids* (P-C) stimulate the proliferative ability and reactivity of connective tissue: they enhance the "inflammatory potential." Thus, they help to put up a strong barricade of connective tissue through which the body is protected against further invasion by the pathogenic stressor agent.

Under ordinary conditions, however, ACTH stimulates the adrenal much more effectively to secrete *antiphlogistic corticoids* (A-C). These inhibit the ability of the body to put up granulomatous barricades in the path of the invader; in fact, they tend to cause involution of connective tissue with a pronounced depression of the inflammatory potential and thus they open the way to the spreading of infection

It is not yet known whether ACTH always stimulates the adrenal to produce the various corticoids in the same proportion and always with a great predominance of A Cs Certain recent experiments[7] suggest that depending upon conditions, ACTH may cause the predominant secretion of one or the other of the steroid hormones Be this as it may, the *somatotrophic hormone* (STH) of the pituitary increases the inflammatory potential of connective tissue very much as the P Cs do hence, it can sensitize the target area to the actions of the latter

It is possible that the hypophysis also secretes some special corticotrophin which induces the adrenal to elaborate predominantly PC-s Indeed, STH itself may possess such effects, but this has not yet been proven In any event, even if ACTH were the only corticotrophin, the actions of the corticoids produced under its influence can be vastly different depending upon "conditioning factors' (such as STH), which specifically sensitize the target area for one or the other type of corticoid action Actually conditioning factors could even alter the response to ACTH of the adrenal cortex itself so that its cells would produce more A Cs or P Cs Thus, during stress one or the other type of effect can predominate

The fundamental reaction-pattern to topical stressors is a local adaptation syndrome with inflammation, to systemic stressors, the general adaptation syndrome Various modifications of these two basic responses constitute the essence of most diseases

Outlook Suggested by These Observations Pasteur, Koch and their contemporaries introduced the concept of specificity into medicine, a concept which proved to be of the greatest heuristic value up to the present time Each individual, well-defined disease, they held, has its own specific cause It has been claimed by many that Pasteur failed to recognize the importance of the "terrain," being too preoccupied with the pathogen (micro-organism) itself His work on induced immunity shows that this is incorrect Indeed, allegedly, at the end of his life he said *"le microbe n'est rien, le terrain est tout"*

The theory which directed the most fruitful investigations of Pasteur and his followers was that the organism can develop specific adaptive reactions against individual pathogens, and that by imitating and complementing these, whenever they are short of optimal, we can treat many of the diseases which are due to specific pathogens

To our mind, the G-A-S represents, in a sense, the negative counterpart, or mirror image, of this concept It holds that many diseases have no single cause, no specific pathogen but are largely due to non-specific stress, and to pathogenic situations which result from inappropriate responses to such non-specific stress

Our blueprint of the pathways through which stress acts may be partly incorrect, it is certainly quite incomplete, but in it we have a basis for the objective scientific dissection of such time-honored, but hitherto rather vague, concepts as the role of "reactivity," "constitution and resistance" or "non specific therapy," in the genesis and treatment of disease

If we may venture a prediction, we would like to reiterate our opinion *that research on stress will be most fruitful if it is guided by the theory that we must learn to imitate—and if necessary to correct and complement—the body's own auto pharmacologic efforts to combat the stress-factor in disease*

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CONGENITAL DYSPHAGIA. NEUROGENIC CONSIDERATIONS *

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Dysphagia in newborn infants and very young children presents a complex and frequently challenging diagnostic and therapeutic problem. It is almost always due either to a congenital anatomic deficiency or to a neuropathologic disturbance

This study was undertaken to outline some neurological causes of dysphagia in newborn infants and very young children The anatomic deficiencies have been stressed frequently, but, as will be shown in this study, there are also neurological abnormalities which cause dysphagia.

Disturbances of deglutition in infants and newborns have not received as much attention in the literature as have the more urgent and dramatic respiratory emergencies of the neonatal period Serious impairment in function of the respiratory tract results from any important dysfunction of the swallowing mechanism, not unlike the death-dealing lung disease seen in patients with bulbar paralysis

It is not uncommon to be consulted for bronchoscopy in newborns with atelectasis in whom the primary disease is actually one of disturbance of deglutition. In infants the respiratory distress may be of such great urgency as to misdirect attention from the primary disease

It is axiomatic that a normally functioning respiratory tract is necessary for normal feeding in the infant. If the respiratory tract is to function normally, a normal or nearly normal swallowing mechanism is essential The true overseer of the respiratory tract is the swallowing reflex Even as in their embryology, the respiratory and upper alimentary

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tracts are destined to remain together and depend upon each other for physiologic normality Early diagnosis of the cause of dysphagia is, therefore, essential to prevent, if possible, irreversible pulmonary damage

REVIEW OF THE NEUROLOGY AND PHYSIOLOGY OF DEGLUTITION [1,2,3,4]

The swallowing mechanism is considered to be composed of three phases the buccal-pharyngeal, the esophageal, and the cardio-gastric phases

The buccal-pharyngeal phase is under voluntary control The food or liquid is pushed backward upon the dorsum of the tongue and by muscular action of the tongue is rolled backward to lie in front of the fauces The oral, nasal and laryngeal surfaces are closed by the lips, tongue and soft palate as the larynx moves upward The myelohyoid muscle contracts and presses the tongue against the hard palate This movement pushes the bolus downward into the pharynx as the larynx returns to its normal position

This phase occurs as a reflex action by stimulation of sensory areas which are scattered over the mucosa of the base of the tongue, the soft palate, and the posterior wall of the pharynx Stimulation of these receptor organs by contact with oral contents causes afferent stimuli to be carried over the glossopharyngeal nerve, the second division of the Vth nerve, and the superior laryngeal nerve to the swallowing center in the floor of the fourth ventricle Anesthetizing these receptors makes swallowing virtually impossible Destruction of the central nerves by any neurological disorder involving this area may result in difficulty with swallowing

The esophageal phase follows reflexly with relaxation of the cricopharyngeal sphincter and the esophagus as a whole Liquids drop immediately by gravity to the ampullary end Solids, however, pass by coordinated peristalsis, reaching the distal esophagus at the end of this phase Even though liquids are thrown down the esophagus without regard to peristalsis, the peristaltic wave which starts at the onset of the esophageal phase continues in its usual manner Peristalsis, at least over the lower two-thirds of the esophagus, is an autonomous function of the esophagus initiated voluntarily in the pharynx and completed by the intrinsic myenteric plexus The reflex continues to function normally even after all central nervous connections are severed as long as the intramural plexuses remain intact

In humans two wave types are seen The primary wave travels without interruption toward the distal esophagus and is the propelling force for the bolus It is initiated by the bucco-pharyngeal phase The secondary peristaltic wave depends on intra-esophageal distention for adequate stimulation Studies suggest that stimulation of the vagi causes contraction of the circular muscle bundles and at the same time causes relaxation of the longitudinal muscle bundles Stimulation of the sympathetics appears to produce just the opposite reaction

The *cardio-gastric phase* begins as swallowed material reaches the ampulla Here, there is a pause and a change in the rhythm as the closing mechanism of the esophagus, just proximal to the stomach, relaxes in quick periods to permit gushes of food to enter the stomach At the cardia there appears to be a rhythmic mechanism for emptying of the ampulla

The diaphragm appears to have little or no control except that on deep inspiration there is a temporary slowing of the flow of the food into the stomach There is a very fine correlation between normal peristaltic activity and the release of the closing mechanism at the cardia The tone of the cardia is inhibited by mild stimulation of the gastric mucosa, and by sensory impulses arising in the mouth and the pharynx Its tone increases as digestion proceeds Any local irritation at the cardia produces hypotonicity The vagus is responsible for a degree of tone at the cardia, at least in the normal resting terminal esophagus Sympathetic stimulation invariably causes contraction of the ampullary end of the esophagus The vagus increases the tonicity of the esophagus at the same time as it relaxes the cardiac end

The origin of the sympathetic supply to the esophagus is in the superior and inferior cervical sympathetic ganglia The former getting its branches from the first to the fourth cervical levels, and the latter largely from the seventh and eighth cervical levels These fibers form a plexus as they join the esophagus organ Within the chest, filaments are supplied by the fourth and fifth thoracic levels and by the preganglionic fibers of both the greater and lesser splanchnic nerves The greater splanchnic nerve gets its fibers from the fifth to the ninth thoracic levels, and the lesser gets its fibers from the ninth and tenth thoracic levels The abdominal segment receives filaments bilaterally from the celiac plexus, and a few fibers from the sympathetic plexus surrounding the left gastric and inferior phrenic arteries

The parasympathetic arises from both vagus nerves which are intimately associated, both anatomically and functionally, with the esophagus The vagi emerge from their pulmonary plexus behind the right and left lung roots and divide into several branches and become arranged along the anterior and posterior surfaces as the complicated net of the esophageal plexuses The left passes anteriorly, and the right swings posteriorly, each with branches from the other forming the anterior and posterior plexuses The plexuses cover most of the lower half of the esophagus, but soon differentiate again and emerge toward their distal portion The left remains anteriorly and the right posteriorly, and they continue closely applied to the esophagus as it proceeds through the diaphragmatic hiatus The recurrent laryngeal nerve gives off several esophageal branches

The intrinsic nerve plexuses consisting of Meissner's and Auerbach's plexuses are comparable with those found elsewhere in the gastrointestinal tract Auerbach's plexus lies between the inner circular and outer longitudinal muscle layers It is in this plexus that the vagal fibers end The other portion of the intrinsic nervous mechanism is Meissner's plexus which makes connections with the myenteric plexus and is found in the sub-mucosal area of the esophagus

REVIEW OF THE LITERATURE

Peiper, in 1942, studied newborn infants with respiratory and swallowing difficulties and concluded that these were due to immaturity of the medullary centers

Macaulay,[6] in 1951, reported a case of a 10-day-old infant with respiratory and swallowing difficulty for a period of 21 days This apparently was due to head trauma with bruising and edema of the medulla He felt that there was a defective closure mechanism of the larynx during deglutition

Otell and Coe[7] point out that paralysis of the esophagus is not a rare condition

Christie,[8] in 1932, described a case of chronic progressive bulbar palsy, and points to the fact that the roentgenologist is often in a position to direct attention toward the possibility of a neuromuscular lesion He described the X-ray appearance of paralysis of the esophagus

Quincke, quoted by Otell and Coe,[7] reported a case of laryngeal ptosis causing dysphagia which was actually a condition of relaxation of the laryngeal musculature

Hurst,[9] felt that in the Plummer-Vinson syndrome the pharyngoesophageal sphincter, which is normally closed, does not relax after the food has been propelled into the pharynx by the tongue, and thus results in retention of food in the posterior pharynx There is no abnormality in the esophagus associated with this syndrome

Riley,[10] in 1952, reported 33 cases of a syndrome which is characterized by evidence of vegetative dysfunction with excessive perspiration, drooling, erythematous blotching of the skin, intermittent hypertension, defective lacrimation, hyporeflexia, and emotional instability All the patients with the complete syndrome were Hebrew No specific neurological abnormality was demonstrated Cyclic vomiting and frequent pulmonary infections occurred in 23 of the group of 33 The problem began at an early age Cystic fibrosis of the pancreas was suspected because of the frequency of pulmonary infection Some had mental retardation and in about half of the patients convulsions were present There seemed to be a familial predisposition Postmortem examinations revealed aspiration pneumonitis in two cases without any specific pathology in the central nervous system He does not stress the swallowing difficulty these children may have

Albanese,[11] in 1949, reviewed the pathology and histology of amyotonia congenita The muscles show degenerative changes secondary to defective innervation Muscle fibers are hypertrophied Some are normal in size and consistency, but many were small or hypoplastic There is no atrophy, merely hypoplasia, of a large portion of the fibers of certain voluntary muscles The dominant lesions of amyotonia congenita were found in the spinal cord The anterior horn cells are degenerated and reduced in number

Allen,[12] stated that cardio-esophageal relaxation refers to total anatomical and physiological incompetence of the distal esophageal segment He used atropine and roentgenologically was able to demonstrate a prominent sphincteric action at the cardia

Palmer[7] points out that in cardio-esophageal relaxation free reflux through the esophagus frequently leads to aspiration pneumonia, and within a few days of birth, severe pulmonary disease may supervene He also states that relaxation is uncommonly associated with other esophageal disease, and apparently rarely with other congenital anomalies

Neuhauser and Berenberg,[13] in 1947 had one case of cardio-esophageal relaxation associated with an esophageal hemangioma They felt that spontaneous recovery within two to five months can be expected, and that cardio-esophageal relaxation of the newborn is a self-limited anomaly

Penner and Druckerman,[14] in 1942, reported two cases presenting disturbance in the esophagus with somatic manifestations of Parkinsonism

Kronecker and Meltzer[15] in 1883, showed that the esophageal phase of deglutition was initiated by stimulation of the superior laryngeal nerve, and it would extend down the entire length of the esophagus even if the segment of the latter was removed if the extrinsic vagal nerve supply was intact

Meltzer,[16] in 1898, demonstrated that the orderly progress of peristalsis of the esophagus is exclusively of central origin

Schmidt,[17] in 1939, studied the effect of stimulation of the glossopharyngeal nerves and the vagi, and demonstrated that the state of tone of the distal portion of the esophagus was influenced by thermal, mechanical and chemical stimulation of the tongue and mouth.

McGibbon and Mather,[18] in 1937, investigated a series of patients with spasm of the esophagus, the youngest of which was eight months of age They theorized that in children there may be a congenital inferiority of the sympathetic nervous system Nervous instability is mentioned by other observers

Olsen, et al,[19] in 1950, point out that cardiospasm is a nonorganic stenosis of the lowermost portion of the esophagus immediately above its junction with the stomach, and is seldom more than 4 to 6 centimeters long They feel that diffuse spasm is not to be confused with achalasia

Holinger, et al,[20] regard achalasia as a failure of coordination of the neuromuscular mechanism at the cardia which prevents normal passage of food from the esophagus to the stomach They point out that the condition can develop in the first few months or years of life, and that it can be present in the newborn infant.

Friedberg,[21] in 1950, reported on the status of the esophagus following vagotomy of 31 patients, and concluded that in the human, the effects of vagotomy on the esophagus are of relatively minor significance

Holinger, et al,[20] state that with a history of dysphagia aspiration pneumonia, and difficulty feeding in an infant, suspicion of a congenital esophageal anomaly should be aroused They emphasize that with postoperative tracheoesophageal fistulas, the development of strictures at the anastomotic site often makes repeated dilatations necessary in order to obtain a functioning lumen

Gross and Neuhauser,[22] in 1951, discussed the congenital anomalies of vascular origin causing compression of the trachea and esophagus, and point out that with this anomaly there is a mild to moderate hesitation in swallowing, but that the respiratory symptoms tend to be aggravated during deglutition

PRESENTATION OF CASES AND DISCUSSION

The cases that were reviewed were too numerous to report in detail, however, certain cases which illustrate the different groups of neurogenic causes of dysphagia are presented in abstract form and are considered under the following headings

A Cortical atrophy, hypoplasia and agenesis

B Familial autonomic dysfunction

C Familial paralysis

D Amyotonia congenita

E Neurogenic esophageal dysfunction

A CORTICAL ATROPHY, HYPOPLASIA AND AGENESIS

Case 1 F T, 10 month-old male first admitted to the Children's Hospital on December 28 1953 The chief complaints were that the child had been unable to swallow since birth, required tube feedings practically all his life and had periodic episodes of vomiting He required resuscitation and was in oxygen for about a month following birth He had convulsive seizures from the first day of life

Examination revealed an undernourished, underdeveloped very thin ten month-old infant Saliva drooled noticeably from his mouth He was irritable and had a weak cry The mandible was hypoplastic The mouth and oral pharynx appeared small, and there was an absent gag reflex Examination of the chest revealed transmitted sounds indicative of tracheobronchial moisture At direct laryngoscopy some difficulty was encountered in exposing the larynx because of micrognathia. The larynx proper was perfectly normal and there was no impairment of mobility of the vocal cords There was conspicuous failure of the constrictor muscles of the pharynx to contract

Neurological consultation revealed hyperactive reflexes almost with spasticity The child could see and hear normally, and had no impairment of sensations The impression was cerebral hypoplasia with spastic quadriplegia resulting from neonatal asphyxia.

The child's course in the hospital was unsatisfactory Feedings attempted by mouth were always aspirated It was therefore necessary to continue tube and gavage feedings The child was discharged unimproved to be cared for in a home for retarded children

Case 2 D B two-month-old female, first admitted to the Children's Hospital on October 21, 1953 The chief complaints were inability to swallow and malnutrition She had never been able to swallow properly, nor to breathe well because of an overabundance of very thick mucus in the throat which was first noted immediately after birth She was a full term normal cephalic delivery Several formula changes were made but the child was still unable to swallow

Examination revealed a poorly nourished underdeveloped infant There was a great deal of mucus in the mouth and pharynx with some drooling but the tongue was dry She was unable to focus her eyes Ex amination of the chest showed many wheezes and rhonchi transmitted from the throat. Direct laryngoscopy revealed a very slight laryngomalacia which was insufficient to account for the respiratory and swallowing difficulty There was a great deal of pooling of secretions in the hypopharynx suggesting obstruction Esophagoscopy showed no evidence of abnormality The pharynx was seen to constrict in normal fashion without evidence of paralysis

Neurological examination revealed bulbar paralysis The reflexes were equal and active and motor activity was normal Impression was deficient neural mechanism for swallowing probably secondary to diffuse hypoplasia of the brain or specific bulbar aplasia.

X rays of the esophagus were reported as showing the lipiodol column to pass through the oral cavity and pharynx during deglutition however it was then regurgitated into the nasopharynx and nasal fossa. Only a small portion of dye passed into the stomach The esophagus was seen to be normally distensible and smooth in outline. There were no pathological findings in the stomach or duodenum and there was no evidence of pyloric obstruction

Attempts at feeding the child produced an interesting series of events Although the child made numerous attempts to swallow the fluid was heard to churn in the hypopharynx and produced choking followed by cough and regurgitation through the nose. The course in the hospital was unchanged She continued to have difficulty feeding and after two and one-half months of hospitalization the child expired

Autopsy findings revealed hypoplasia of the brain broncho pneumonia and malnutrition. The brain weighed 390 grams (normal 540 grams) There was increased space between the inner surface of the skull and brain although the sulci and gyri showed no gross abnormalities. Sectioning showed marked diminution in the amount of white matter The grey matter appeared to be normal although perhaps slightly increased in thickness The dorsal portion of the grey matter surrounding the lateral horn showed great discoloration for a distance of 2 3 mm. At the tip of the fourth ventricle there was a small nodule of grey tissue On sectioning the brain stained poorly and there was generalized degeneration of the nuclear elements

Case 3 (See Fig 1) P T., one-month-old female first admitted to the Children s Hospital on May 28 1950 The chief complaints were that the child had considerable difficulty swallowing since birth persistent gagging and had a great deal of mucus in the mouth and throat, which required suctioning Because of the extreme difficulty in swallowing it was necessary to use gavage feeding This was a first pregnancy normal delivery The mother had a history of atypical pneumonia in the second month of pregnancy and hydramniose and hypertension in the third trimester At birth the child had considerable generalized edema

Examination revealed no gross abnormalities The heart was of normal size and the lung fields were normal

X ray of the esophagus revealed a persistent defect in the right side of the esophagus which was in keeping with an anomalous right subclavian artery It was assumed that this was the cause of the swallowing difficulty

On June 7 1950 the child had a thoracotomy and a large right anomalous subclavian vessel was found This was resected and the ductus arteriosus ligated Following surgery the child did not show any improvement in her ability to swallow She was discharged on June 17 1950

She was readmitted to the hospital on August 3 1950 for further study

X rays of the esophagus on this admission, revealed no evidence of any obstruction Esophagoscopy was done, which revealed considerable relaxation and folding of the esophageal walls There was no evidence of stricture, and no other abnormality was noted On this admission however, there were findings of contracted pupils The pediatric consultant considered this to be due to a paralysis of the cervical sympathetic dilators of the pupils, and it was felt that this was associated with congenital defect in innervation of the esophagus The child was discharged unimproved She was again admitted on September 13, 1950 with suspicion of hypoplasia of the cerebral cortex because her development had not been normal A pneumoencephalogram showed marked widening of the sulci consistent with cerebral agenesis and she was discharged unimproved On June 25, 1951 the child expired

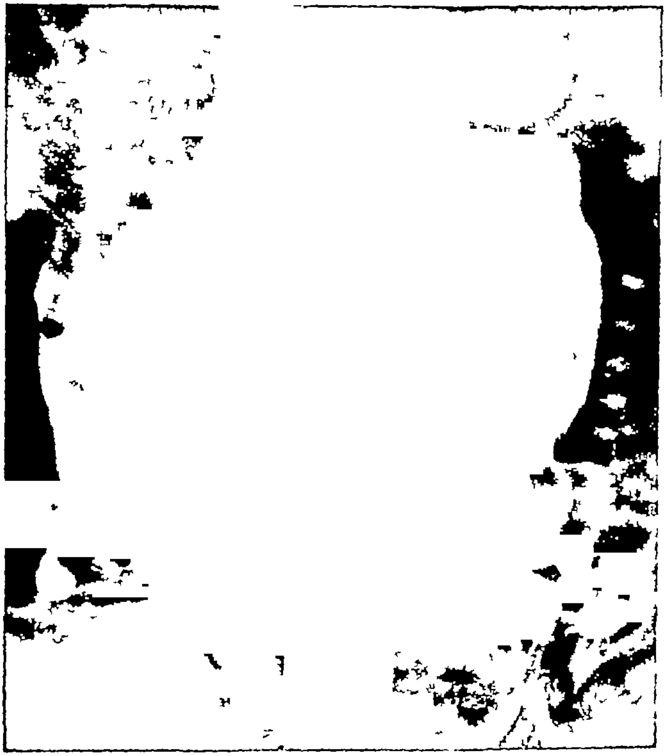

Fig 1 (Case 3) Esophagogram showing a defect in the esophagus due to compression by a large anomalous right subclavian artery The esophagogram on the right is postoperative The defect is not seen but there is retention of dye and slow evacuation

Autopsy (verbal report of the pathologist) revealed no positive findings in the esophagus respiratory or gastrointestinal tracts There was agenesis of the brain of a severe nature

DISCUSSION

Transient disorders[6] of the swallowing mechanism may occur in the newborn infant as a result of prematurity, obstruction of the air passages, or from minor bruising or edema of the medullary centers of the brain

When there is no gross anatomic defect found in a child with persistent dysphagia, neurogenic difficulties should be suspected These may be due to (*a*) intracranial hemorrhage or edema from trauma, (*b*) brain damage from hypoxia or anoxia and (*c*) developmental disorders of the central nervous system or its peripheral connections

Since the behavior of the infant at birth is largely a result of a reflex activity depending on spinal, cerebellar and brain stem centers,[23] it is frequently difficult to evaluate central nervous system development The early finding of neurogenic difficulty with deglutition may be one of the earliest clinical indications of cerebral hypoplasia or agenesis

In the first case neonatal hypoxia was an important factor in producing a widespread neurological disorder The absent gag reflex and the failure of the pharyngeal muscles to constrict indicated central disease with paralysis This differs from the second case in which there was no clinical evidence of paralysis of the pharynx Here, the child's attempts at swallowing were ineffectual and represented difficulty, undoubtedly due to failure of the normal coordinating mechanism, *i.e* , abnormality in discharge of coordinated impulses from the swallowing center This center[1] is in the lower medulla, not precisely localized

The third case is presented because even though the dysphagia was of the same type as Case 1, there was an associated anomaly (anomalous right subclavian artery) which was presumed to be the cause of the dysphagia It must be emphasized that anomalies of the great vessels do not produce serious difficulty in swallowing

B FAMILIAL AUTONOMIC DYSFUNCTION

Case 4 (See Figs. 2 3) S W, four and one-half year-old female first admitted to the Children s Hospital on November 18 1951. The chief complaints were vomiting fever apathy and listlessness of one day s dura

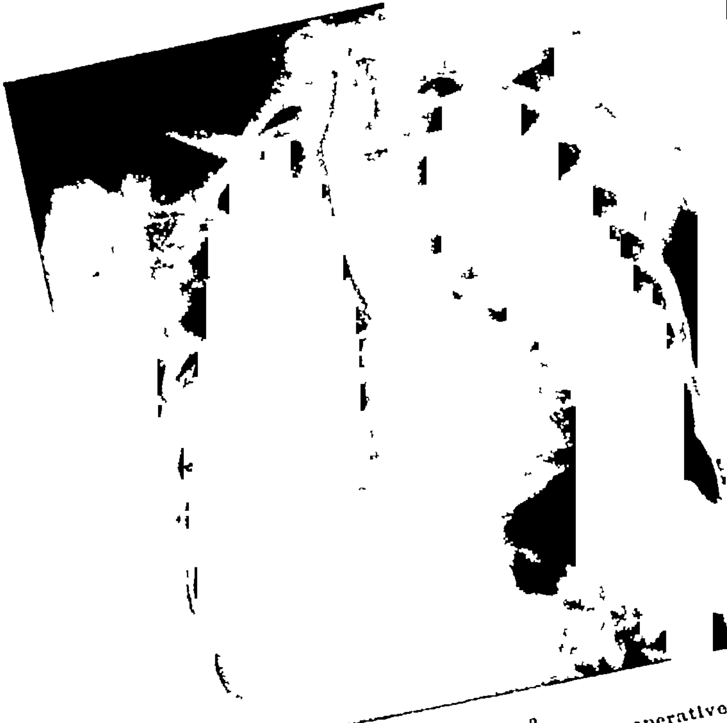

Fig 2

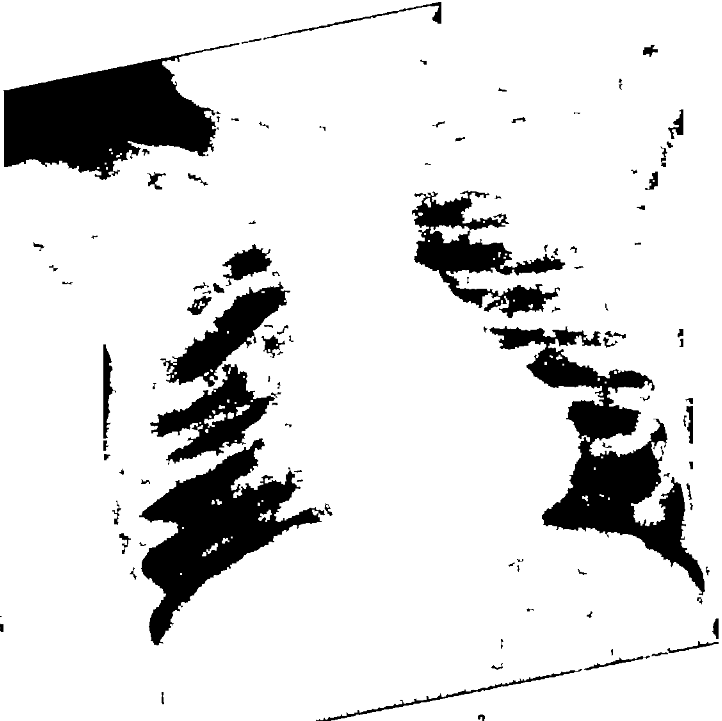

Fig 3

Figs 2 and 3 (Case 1) Shows operative defects in the right 3rd 4th and 5th ribs posteriorly Retention of dye in the esophagus due to prolonged emptying time and evidence of aspiration pneumonitis tion. The past history was most important. The child had always been a very slow feeder and had gained weight poorly Since birth she had choking spells during feedings, when she would gasp and become cyanotic. These symptoms lasted until the age of seven months at which time she developed pneumonia and was seen at an Eastern clinic In May or June of 1949 despite negative X ray studies but because of the very strong suspicion of tracheo-esophageal fistula, thoracotomy was performed but no pathology was found. The difficulty in feeding persisted and gastrostomy was done

At the age of two years, oral feedings became possible although she developed intercurrent bronchial infections. Wheezing was noted after the child drank liquids but solid foods were taken with less difficulty

Examination on admission revealed marked muscle flaccidity There were rhonchi and moisture in the lungs X rays showed bronchitis. The child was treated for the febrile reaction which cleared and she was discharged with a tentative diagnosis of amyotonia congenita She was readmitted on July 10 1952 because of recurrence of vomiting Her general condition had progressed and she was much worse During feeding she aspirated and developed marked difficulty in breathing She was admitted with the diagnosis of aspiration pneumonitis On this admission bronchoscopy was required on two occasions in order to remove the aspirated feedings, and to clear the atelectasis Again the diagnosis was amyotonia congenita although a suspicion of some bulbar palsy was considered She was discharged on July 23 1952

On the third admission for febrile reactions with vomiting and difficulty in swallowing it was noted that there was deficient lacrimation emotional instability hyporeflexia periodic muscular weakness hypertension, and peripheral vascular collapse, and the diagnosis of Riley Day syndrome was made. She has had 14 hospital admissions to date all because of repeated acute flare-ups of autonomic disturbances

X ray study of the swallowing mechanism was done on November 4 1953 Report of Dr Humphrey operative defects of the third fourth and fifth ribs posteriorly the site of operation for the suspected tracheo-esophageal fistula, is noted. The esophagus is retracted to the right of the usual anatomical position in the upper and mid-dorsal region. During deglutition the dye column proceeds through the pharynx and cervical esophagus promptly but the transit time is prolonged in the dorsal esophagus. Evacuation of the dye through the cardiac orifices occurs relatively infrequently but more promptly in the erect than in the recumbent position. Reverse peristalsis is evident in the dorsal esophagus There is no evidence of an anatomic stenosis of the esophageal lumen. Roentgen impression is esophageal motor dysfunction.

Case 5 (See Fig 4), S S, six week old male first admitted to the Children's Hospital on April 21 1952 The chief complaints were recurrent episodes of cyanosis and choking, particularly during feedings The child is a product of a normal delivery but was premature The past history is important in that the child had respiratory difficulty associated with difficulty in swallowing immediately after birth X rays of the chest on the first day of life showed congenital atelectasis of the right upper lobe The child had been discharged from another hospital just three or four days prior to his admission to the Children's Hospital On the day before admission he had suddenly become very cyanotic, developed severe expiratory respiratory difficulty during feeding He was admitted with the diagnosis of aspiration pneumonitis

X rays of the chest revealed unresolved congenital atelectasis of the right upper lobe Bronchoscopy was done and a large amount of thick purulent secretions were aspirated from the tracheobronchial tree There was no anatomic abnormality of the tracheobronchial tree or larynx Following bronchoscopy X rays revealed marked clearing of the atelectasis Because of the persistent difficulty with swallowing and constant aspiration a tracheo-esophageal fistula was suspected but could not be demonstrated on X ray of the esophagus

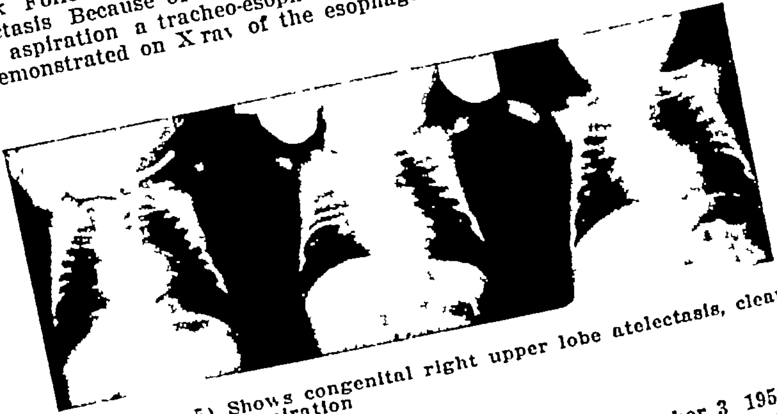

Fig 4 (Case 5) Shows congenital right upper lobe atelectasis, clearing after bronchoscopic aspiration

The course in the hospital was stormy, and on November 3 1952 the child had another severe cyanotic episode during feeding, and required emergency bronchoscopy Following this the lung cleared, and his general condition improved All the studies attempting to account for the difficulty in swallowing and the continued vomiting with aspiration were negative Feedings were given by polyethylene tube and the child was discharged on November 27, 1952 with the diagnosis of feeding problem of undetermined etiology

He was readmitted on May 5, 1953 at the age of eight months with the history that he had been on gavage feedings since leaving the hospital He has however begun to take small quantities of solid food with a spoon although feeding and swallowing has still remained very difficult On this admission the chief complaints were abdominal distention high fever and vomiting At this time it was noted that the child had no head control, was areflexic, and was relatively insensitive to pain by pinprick but was alert When the child cried there were no tears and he had excessive diaphoresis The diagnosis of a familial autonomic dysfunction was then obvious

DISCUSSION

This group of patients have been most interesting and extremely difficult from the diagnostic standpoint The feeding difficulties were of such great moment that in both of the cases the recurrences of pulmonary disease led either to the suspicions of tracheo-esophageal fistulae or some anatomic obstruction These were not found on intensive clinical investigation

In the first case in this group, surgery was performed to close a tracheo-esophageal fistula which was not found In the second case, the recurrence of broncho-pulmonary suppuration led to the strong feeling that this was a constitutional disturbance, such as cystic fibrosis of the pancreas All other diseases and anomalies had been ruled out. All forms of therapy had failed, and it was only after other symptoms were observed that the true diagnosis became obvious

An understanding of the mechanism is suggested by the esophageal studies in Case 4 which showed delayed evacuation of the dye medium (lipiodol) in the dorsal and also the ampullary end of the esophagus This strongly suggests autonomic nervous system disease, which governs the neuromuscular function of the lower two-thirds of the esophagus and cardia This finding is in keeping with other evidences of generalized autonomic disturbances Another possible etiology of the defective evacuation of the esophagus will be discussed under Group E

C FAMILIAL PARALYSIS (BULBAR)

Case 6 (See Fig 5) L. A. two-week-old female, first admitted to the Children's Hospital on June 8 1954 The chief complaint was cyanosis due to excessive mucus in the throat immediately after birth She had been unable to feed because of difficulty in swallowing with choking and had been fed by gavage She was transferred to the Children's Hospital for study of the suspected paralysis of the throat. She is the product of a full term normal delivery

Examination revealed an active infant whose cry was hoarse but there was no stridor There was an excessive amount of mucus in the pharynx and in the mouth. The palate was high and did not move well There was a very marked diminution of the gag reflex. The infant appeared to be quite normal except for these findings

Neurological examination showed that the palate did not elevate spontaneously or reflexly No other neurological abnormalities were present.

The impression was that this was neither amyotonia nor myasthenia gravis A congenital local abnormality or a very specific bulbar nuclear aplasia was suspected

Direct laryngoscopy demonstrated paralysis of the left true cord in the midposition The esophagus appeared normal but the introitus was wide open as though the crico pharyngeus were paralyzed

Developmental clinic consultation showed no marked deviation from the normal at this age

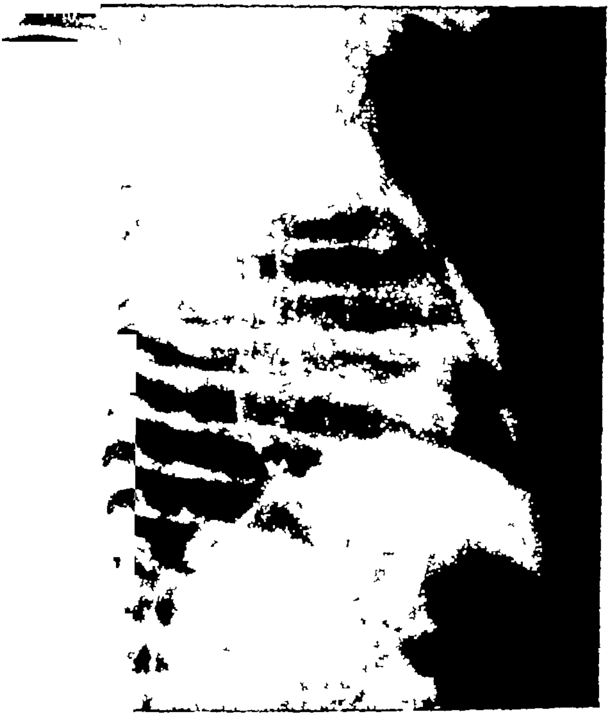

Fig 5 (Case 6) Lipiodol swallowed inadvertently produced aspiration bronchogram showing mechanism of broncho-pulmonary disease in a case of bulbar paralysis

The course in the hospital has been one of great difficulty from the standpoint of maintaining nutrition Gavage feedings are taken well but any attempts at feeding orally cause aspiration pneumonitis Large amounts of mucus in the oral cavity and hypopharynx require constant nursing At the writing of this paper, the child is still unable to feed

X rays of the esophagus showed that the iodized oil remained in the nasopharynx with slight aspiration into the trachea The swallowing reflex appeared to be absent and when oil did pass into the upper esophagus it was carried down by what appeared to be normal peristalsis There was no evidence of esophageal disease

Family History This child is a product of the mother and second husband The first child 19 years old is living and well and is the product of the first husband and mother He had no swallowing difficulty The second child is a 15-year-old male who is living and well but who is small for his age and weighs only sixty pounds. He is a product of the second husband and the mother At birth this boy had extreme difficulty with swallowing and was kept in the hospital for many months because of paralysis of the throat His ability to swallow gradually improved and since the age of two years apparently had been quite well There also were two male children 12 and 7 years of age who are living and well and who have no history of swallowing difficulty One child born nine years ago and another born five years ago died shortly after birth because of difficulty with swallowing They presented a picture similar to the child whose case history is given here The father had a brother who died of "spasm in early infancy No other information about this individual is available

DISCUSSION

This case does not actually represent a special category of dysfunction It is merely presented as a special problem of hereditary dysphagia due to a very specific bulbar dysplasia There is no evidence of cerebral abnormality in the children of this family That the problem is not a local defect as in Cases 1, 2 and 3 is evidenced by the fact that the palate, pharynx, vocal cord, and cricopharyngeus are all involved This is in keeping with the diagnosis of central or nuclear (bulbar) dysphagia.

D AMYOTONIA CONGENITA

Case 7 (See Figs 6 7) L. P., eight and one-half month-old female first admitted to the Children s Hospital on July 15 1952 The chief complaint was difficulty in breathing which started while she was being fed. A few days prior to admission she choked and became cyanotic and required artificial respiration.

Examination on admission revealed a completely flaccid atonic pale infant with rapid and shallow breathing There was considerable mucus filling the throat and the mouth. The gag reflex was very poor There was marked deformity of the chest with decreased expansion of the right side. The ribs flared on the left side The trachea was shifted to the right. There were harsh breath sounds heard over the right side which is flat and dull to percussion. The left side was clear to auscultation but there was hyper resonance to percussion The heart was shifted to the right. The extremities were markedly atonic areflexic, and the ligaments were very relaxed. The diagnosis was aspiration atelectasis

X rays revealed the right lung field to be obscure. The heart was pulled to the right chest suggestive of marked atelectasis The X rays revealed marked deficiency of the musculature of both arms suggesting a neuromuscular disorder The child was bronchoscoped on July 16 1952 The larynx was normal, and the cords moved normally There was considerable secretion in the trachea and right bronchial tree The left bronchial tree was normal Following bronchoscopy the child s respira tory distress cleared but the general condition remained unchanged Feedings were given by tube On July 26, 1952, the chest was normally expanded, and the child's condition was very much improved On August 8, 1952 following an attempt at feeding by nipple the child suddenly became dyspneic and cyanotic from aspirated formula Bronchoscopy

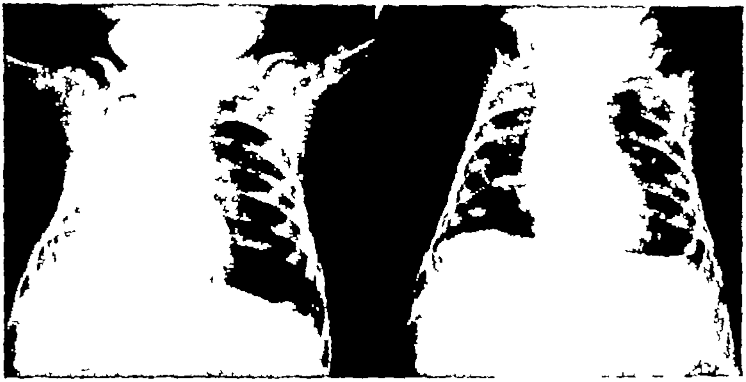

Fig 6 (Case 7) Showing complete atelectasis of the right lung and after bronchoscopy clearing of the right atelectasis and return of mediastinum to normal position

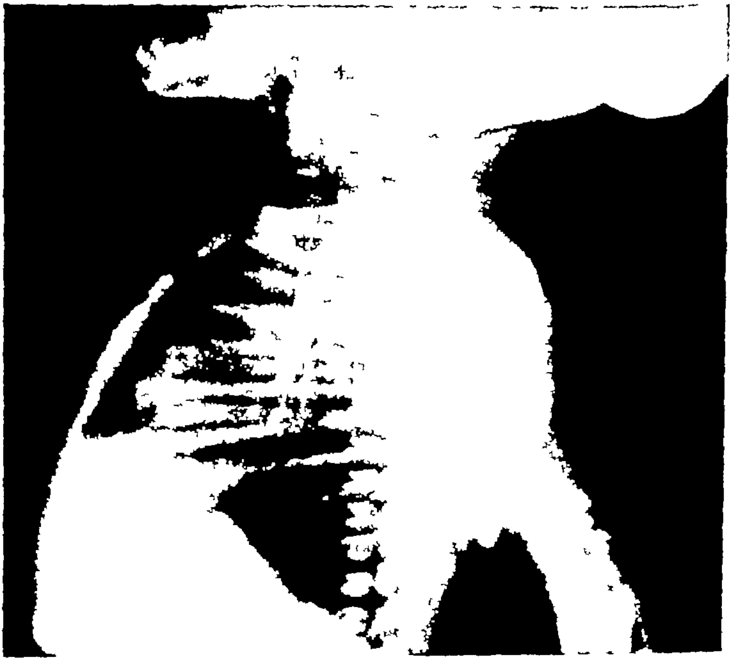

Fig 7 (Case 7) Showing aspiration on swallowing All the opaque medium is in the tracheobronchial tree—none in the esophagus

was done, a large amount of milky secretion was removed from both bronchi, and her condition improved

Neurological examination revealed an aspiration problem on the basis of bulbar pathology and the diagnosis of amyotonia congenita was made

On August 9 1952 the child apparently aspirated her own secretions and expired.

Autopsy confirmed the diagnosis of amyotonia congenita and also the presence of bronchopneumonia and right lower lobe atelectasis due to aspiration

DISCUSSION

Children in this group develop their defective swallowing mechanism with progression of their disease Muscular atony develops and progresses and involves all voluntary musculature. Dysphagia, together with marked weakness of the cough reflex causes recurrent attacks of aspiration pneumonitis just as it does in bulbar poliomyelitis

In reviewing all of the cases of amyotonia congenita which came to autopsy at the Children's Hospital the chief cause of death was pulmonary disease with obstruction to the tracheobronchial tree from aspiration of feedings

E NEUROGENIC ESOPHAGEAL DYSFUNCTION

Case 8 (See Fig 8) S. F six month-old male first admitted to the Children's Hospital on March 11 1949 The chief complaints were gagging on feeding, and vomiting spells

Examination was essentially negative except for evidence of dehydration.

Barium X rays showed the esophagus to be very dilated. The barium ran out of the lower end of the esophagus at the same speed as it entered. The form and function noted on X ray resembled cardiospasm.

The child was discharged on March 18 1949 to be followed by his physician for a trial of medical treatment. He was admitted again on October 4 1949 because he had continued to vomit. A Heineke-Mickulics plastic type operation was performed and he was discharged on November 9 1949 in good condition He was readmitted on November 20 1950 with the diagnosis of stricture of the esophagus with the complaint of continued dysphagia. Esophageal dilatations for correction of postoperative esophageal stenosis had been done in this child without benefit.

On November 22 1950 esophago-gastrostomy was done, and the child was discharged on December 2 1950 He was readmitted on February 11 1951, because of hematemesis. Esophagoscopy revealed no cause for the bleeding He has since been readmitted on numerous occasions because of bleeding, and has required transfusions These episodes of bleeding have spontaneously subsided.

At this writing the child is reported to have only moderate swallowing difficulty A postoperative X ray of the esophagus revealed marked reflux of gastric contents up the esophagus through the anastomosis

Case 9 (See Fig 9), A C three-month-old female first admitted to the Children's Hospital on November 8, 1952 The chief complaints were difficulty in feeding since birth associated with choking and vomiting The child had been discharged from the hospital three days after delivery to be fed by dropper She could take about one-half ounce of formula in this manner after which she would choke and begin to vomit She lost weight rapidly and was admitted to another hospital where she was tube fed for approximately two and one-half months

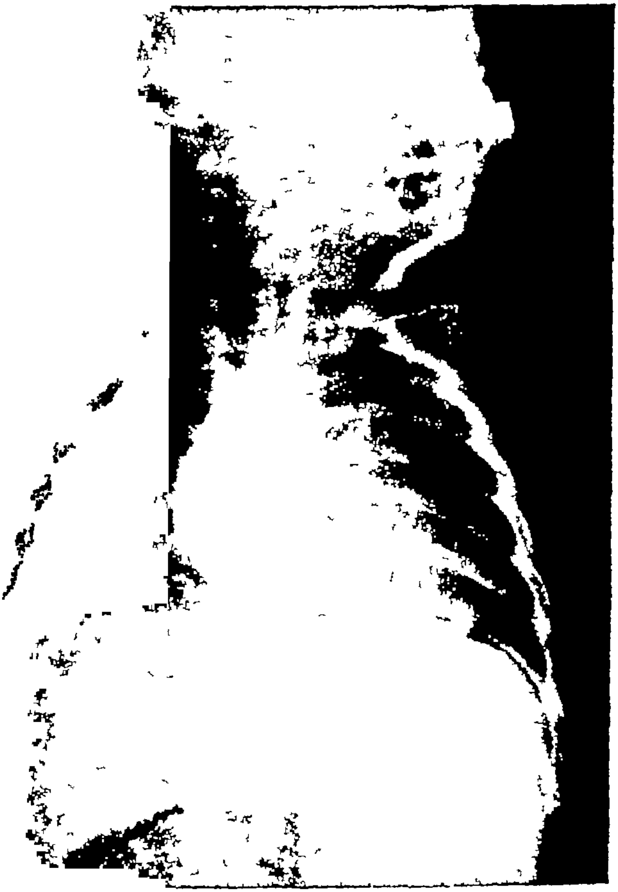

Fig 8 (Case 8) Showing marked dilatation of the esophagus retention of barium Spasm of lower end of esophagus in cardiospasm

On admission to Children s Hospital, examination revealed cleft palate, deformed cartilage of the ears inability to hold the head erect and out ward deviation of the left eye The lower jaw was underdeveloped The chest was clear to percussion and auscultation except for rhonchi which were transmitted from the throat. Neurologically the child was normal except for poor muscle tone The diagnosis was Pierre-Robin syndrome with feeding problem.

X ray studies revealed no evidence of obstruction in the esophagus or stomach Reflux of gastric contents occurred readily through a patulous cardiac orifice Esophageal reflux occurred for the most part during inspiration and during forced expiration when the child strained or cried

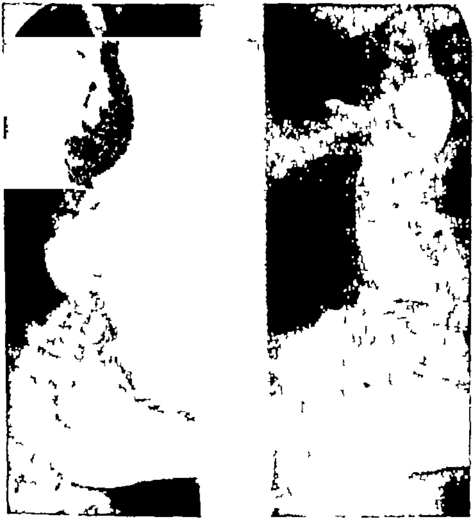

Fig 9 (Case 9) Chalasia—showing marked tortuosity and widening of the esophagus with reflux through a wide open cardia.

Retention of gas and fluid in the dilated and tortuous esophagus was abnormally prolonged Propulsive activity was evident in the esophagus with the patient in a horizontal position. The lumen contracted to a normal caliber and the esophageal contents were evacuated into the stomach and subsequently into the duodenum without delay A small segment of the gastric fundus herniated through the esophageal hiatus intermittently during forced respirations There was also evidence of aspiration pneumonia and bilateral cervical ribs

A glossoplasty was done at which time the tongue was sutured to the lower lip Following this she continued to have difficulty swallowing but due to the fact that the tongue could not ptose into the pharynx feeding and grasping of the nipple particularly, was made much easier She has continued to have the same difficulty feeding, but has developed nicely

Case 10 (See Fig 10) H F 11 year-old female, first admitted to the Children's Hospital in April, 1950 The chief complaint was that this child had always had great difficulty in swallowing since very early infancy There was always very slow feeding with gagging and frequent vomiting Many formula changes were made without any effect. Nervousness was considered to be the etiology of her swallowing difficulty Her development has been normal in every respect with the exception of continued difficulty in swallowing solid foods

X ray revealed three inches of spasm of the esophagus in its middle one-third Drugs failed to cause relaxation, and the esophageal lumen never returned to normal size No other abnormality was present

Fig 10 (Case 10) Demonstrates 3 inches of spasm of the esophagus in its middle one third The two photographs to the right were taken after relaxing drugs were used without effect

Esophagoscopy was done and there was considerable retention in the esophageal lumen There was great redundancy of the upper one-third of the esophagus with abnormally large folding due to dilatation In the mid esophagus a marked degree of spasm was encountered but the esophagoscope proceeded into the lower third of the esophagus where a small narrowing was noted This had the appearance of a stricture Following dilatation the child's ability to swallow improved The findings were very suggestive of a congenital short esophagus

She is now 14 years old and has had repeated dilatations This is a case of esophageal stricture in a patient with congenital short esophagus with non-sphincteric spasm

Case 11 (See Fig 11) C K one-day-old male first admitted to the Children's Hospital on June 23 1951 The chief complaints were inability to care for his mucus, and dysphagia.

X rays revealed the esophagus to end in a blind sac with a markedly distended abdomen and excessive gas in the stomach and small bowel Interpretation was atresia of the esophagus with congenital tracheo-esophageal fistula Routine closure of the tracheo-esophageal fistula and an end-to-end anastomosis of the esophageal segments was performed on June 23 1951. Surgical exploration revealed the usual type of tracheo-esophageal fistula with a blind upper pouch and the lower segment connected to the trachea His postoperative condition was good On July 1 1951 formula and bubbles were noted to come out of the drain in the chest wound Methylene blue was given orally and this came out of the chest wound indicating an esophago-pleural fistula All feedings were discontinued for a period of a week, and when feedings were again started the child choked and was considered to have a stricture of the esophagus. Esophageal dilatations were done but the child did poorly and had numerous episodes of aspiration pneumonitis He was discharged on August 5 1951 and readmitted on September 6 1951 with a recurrent bronchopneumonia and esophageal stenosis.

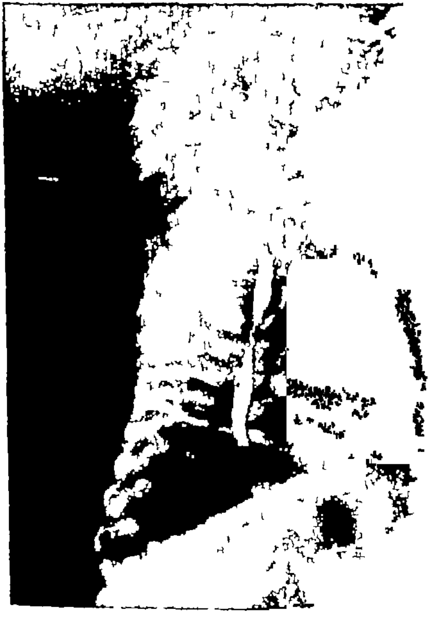

Fig. 11 (Case 11) Showing stricture at anastomotic site and tracheo esophageal fistula which recannulated

X rays of the esophagus with lipiodol taken on October 18 1951 revealed considerable difficulty in initiating the swallowing mechanism Lipiodol was noted in the hypopharynx and trachea indicating aspiration, or a recurrent fistula

On September 25, 1951, a thoracotomy was done and a recannulated fistula was found and closed The scar which closed the esophagus almost completely was resected and the esophago-pleural fistula was closed Following this operation, the child did much better but continued to have difficulty in swallowing in spite of dilatations, and what appeared to be an adequate esophageal lumen

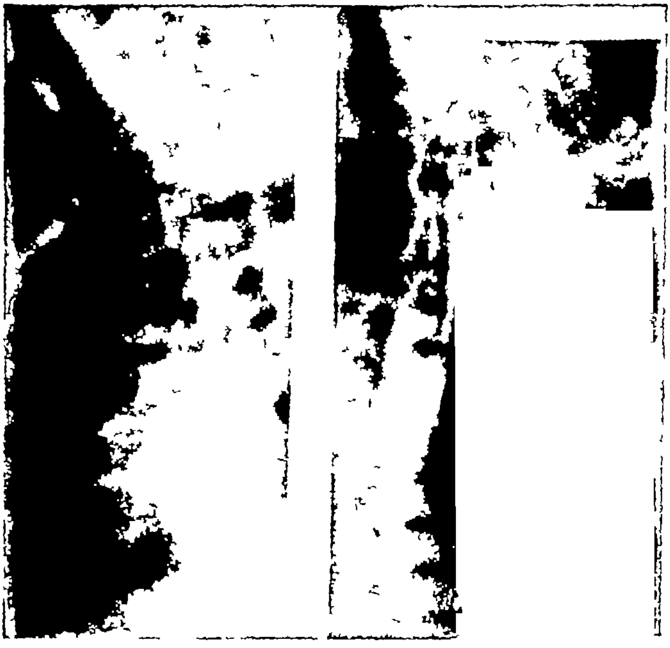

Fig 12 (Case 12) Esophagogram showing reflux of lipiodol into trachea and showing duplicated esophagus ending in blind sac at level of T-3 Delayed emptying time of esophagus was noted and walls are atonic.

On June 30 1953 X rays of the esophagus showed that the lipiodol passed the upper esophagus and the anastomosis without significant delay Peristaltic activity in the esophagus below the anastomosis was somewhat impaired which resulted in delayed esophageal emptying This was more pronounced in the horizontal than in the erect position The esophagus was retracted to the right and there was very slight narrowing of the lumen at the level of the anastomosis The Roentgen impression was esophageal motor dysfunction with impairment in peristaltic activity below the anastomotic site

Case 12 (See Fig 12) M V three-day-old female, first admitted to the Children s Hospital on August 2 1954 The chief complaints were difficulty in swallowing cyanotic episodes on attempting to feed and a hoarse cry She was a first child of an uneventful pregnancy and a spontaneous delivery

Examination revealed congenital atresia of the right ear with deformity of the right auricle. There was a partial paralysis of the right facial nerve involving the lower lip and a very active gag reflex There was a loud stridor on inspiration with a moist rattling of mucus in the upper respiratory tract The voice was somewhat hoarse. The child was unable to swallow without coughing and becoming cyanotic. The mouth and pharynx contained excessive amounts of saliva and mucus secretion The remainder of the general examination was not abnormal

X ray of the chest revealed a right upper lobe atelectasis X rays of the esophagus with lipiodol showed a free passage through the esophagus into the stomach Peristalsis in the esophagus appeared markedly abnormal in that there appeared to be practically no contractibility of the esophagus and the bolus remained unusually long in the mid-esophagus No evidence of a tracheo-esophageal fistula was noted There was bifurcation of the upper esophagus which on the left side ended in a blind pouch The right side formed the functioning esophagus. The blind pouch ended at the third thoracic vertebral level.

Direct laryngoscopy revealed rotation of the larynx counter clockwise The true cords appeared normal and the lumen adequate There were two distinct openings into the esophagus below one on the left taking off near the pyriform sinus, and another to the right posteriorly to the cricoid eminence. There are numerous small tags on the posterior wall of the hypopharynx posterior to the cricoid eminence These are undoubtedly due to congenital deformities in the development of the larynx

An exploratory operation was performed on August 17 1954 at which time no tracheo-esophageal fistula was found An enterogenous cyst was removed The child s swallowing difficulty persisted and she expired on September 1 1954

Autopsy findings showed the true cords to be normal The cricoid cartilage is deficient posteriorly A few millimeters to the left of the cricoid cartilage is a 3 mm opening into a blind pouch which is within the lumen of the esophagus. There is a small opening measuring 2 mm in diameter between the esophagus and the larynx in the area where the cricoid and first tracheal ring are deficient. The fistula is lined by mucosal epithelium At the level where the trachea arises there is an accessory trachea which measures 8 cm. in length and which has tracheal cartilage in the wall This ends in a small glob of what appears to be normal lung tissue (2 5 cm long by 1 cm wide) There is no fistula between the accessory trachea and the esophagus No tracheo-esophageal fistula is present. The normal trachea is normal in size and length but the cartilages appear crooked and anomalous The esophagus is a pliable structure with an intact mucosa with the previously mentioned opening into the laryngeal area The sections appear normal The brain is normal.

Case 13 (See Fig 13) L. A. two and one-half year-old female first admitted to Children s Hospital on June 18 1954 The chief complaints were difficulty in breathing and feeding. She vomited most of the feedings and had failed to gain weight She was a full term normal delivery She was reported to have had hoarseness at birth and was sent home at three days of age Frequently during feedings the child stopped breathing turned blue coughed and regurgitated There was no difficulty in breathing except when she was fed.

Examination was negative except that the infant was undernourished and underdeveloped. There was considerable mucus in the hypopharynx The palate and the pharynx moved normally Neurological examination was normal Fluoroscopic examination revealed narrowing of the distal one-third of the esophagus with dilatation of the proximal portion The lipiodol passed into the stomach and then refluxed back into the esophagus It was difficult to tell where the esophagus ended and the stomach began

On July 19, 1954 esophagoscopy was done and considerable watery mucoid secretion was seen in the upper esophagus indicating retention The scope passed through the entire length of the esophagus with ease No stricture or narrowing was seen, however, gastric folds were observed considerably above the diaphragm suggesting a congenitally short esophagus

The child was discharged, and again admitted on July 25, 1954 with persistent difficulty in swallowing, diarrhea vomiting and difficulty in breathing Examination revealed an aspiration bronchopneumonia On August 3, 1954, X rays were repeated, and these revealed an esophageal hiatus hernia with short esophagus There was evidence of esophagitis and ulceration with chalasia

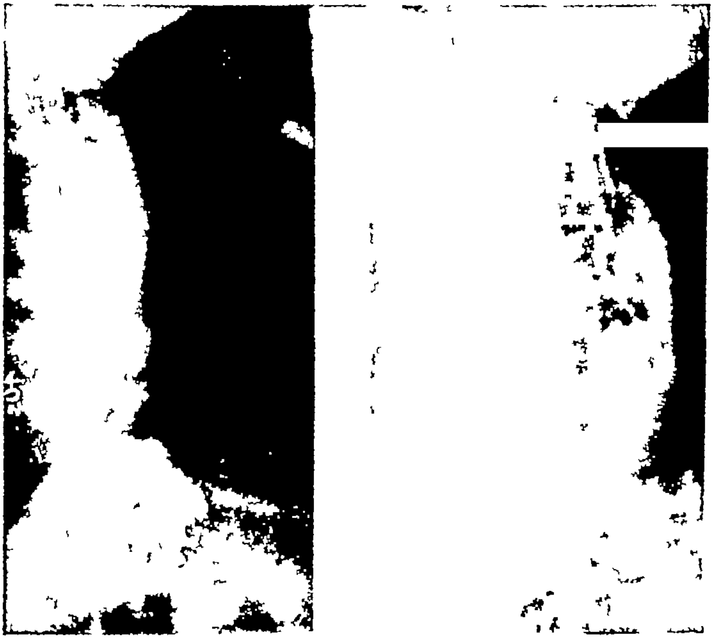

Fig 13 (Case 13) Case of short esophagus with thoracic stomach In which the esophagogram failed to show where esophago-gastric junction is In the figure on the right reflux of dye from the stomach is seen

The child continued to have difficulty swallowing and to lose weight She expired on August 17 1954

Autopsy findings were congenital anomalies of the gastro-intestinal tract short esophagus hiatus hernia thoracic stomach esophagitis and gastritis There were also findings of bronchitis bronchopneumonia and emaciation

DISCUSSION

All the cases in this group, with the exception of Case 8, (cardiospasm) had a congenital developmental anomaly of either the respiratory tract, the esophagus, or both This contradicts the opinions of some writers that chalasia does not occur in association with other anomalies Our cases of cardio-esophageal relaxation were associated with cerebral agenesis, congenital short esophagus, postoperative cases of cardiospasm, and a case of laryngo tracheo-esophageal anomaly

Of the three cases of short esophagus, two had no evidence of stricture (one case is not reported here) however, these two cases had dysphagia much more severe than one would expect from the presence of a thoracic stomach The marked prolongation of the evacuation time of the esophagus, without evidence of organic stricture or functional spasm, tends to incriminate the neuromuscular mechanism of the esophagus The third case showed the presence of non sphincteric spasm and an organic stricture which probably resulted from the prolonged esophagitis due to reflux of gastric juices through the cardio-esophageal sphincter

The remaining cases in this group were problems of tracheo-esophageal fistulas Evidence has accumulated that the severe dysphagia in these cases of tracheo-esophageal fistula is very likely to be partly of neurogenic origin While it is true that postoperative esophageal stenosis or recannulation of the tracheo-esophageal fistulas will cause severe dysphagia experience has shown that even when these factors are controlled troublesome dysphagia persists in many of these infants and can be demonstrated fluoroscopically

Eight patients, not reported here, were studied radiographically In all of these patients, except one, there was delayed emptying of the lower esophageal segment and incoordinated or impaired peristaltic activity

It is interesting to note that the one patient who had no dysphagia postoperatively had a normal esophagus by X-ray This patient had a continuity of the muscular coats of the two segments except where the lower segment joined the trachea The lumen of the upper was not continuous with the lumen of the lower

It may be theorized that the dysphagia in this group of patients is due to (*a*) congenital abnormality of the intrinsic nerve supply, (*b*) congenital abnormality of the extrinsic nerve supply, or (*c*) surgical disturbance of the esophageal autonomic plexuses during repair of atresias and tracheo-esophageal communications The effect of a smaller lower segment on the swallowing mechanism still remains unknown

TREATMENT

In general, therapy is directed toward maintenance of nutrition, and prevention and treatment of complicating broncho-pulmonary disease

The respiratory problem is handled by the prevention of aspiration of saliva and feedings by frequent oropharyngeal suctioning, discontinuance of oral feedings, and where necessary, bronchoscopy to relieve obstruction and atelectasis Tracheotomy may be of benefit in selected cases

Nutrition may be maintained by parenteral fluids, gavage feedings, or by feedings through an indwelling polyethylene naso-gastric tube

The position of the patient is important In cases of bulbar paralysis, a head low position is preferable The upright position is necessary in those cases where there may be regurgitation from retained food in an esophagus in which there is delayed evacuation, or reflux through an incompetent cardio-esophageal sphincter

SUMMARY AND CONCLUSIONS

1 Dysphagia in newborn infants and children produces serious broncho-pulmonary complications

2 Cases of dysphagia especially related to disturbances of neuro-physiology are presented and discussed under the following headings

a Cortical atrophy, hypoplasia and agenesis

b Familial autonomic dysfunction

c Familial paralysis

d Amyotonia congenita

e Neurogenic esophageal dysfunction

3 Transient disorders of deglutition may occur in newborn infants as a result of prematurity, obstruction of the air passages, or from mild intracranial trauma Persistent dysphagia in a child in whom there is no gross anatomic abnormality should arouse suspicion of a more serious neurogenic cause

4 The finding of neurogenic dysphagia may be one of the earliest clinical indications of cerebral hypoplasia or agenesis

5 The persistence of dysphagia in children who have had surgical correction of anomalies indicates the possibility of a defect of innervation

6 Cases of familial autonomic nervous system disease causing dysphagia are presented

7 An unusual case of familial bulbar aplasia causing severe dysphagia is reported

8 Cardio-esophageal relaxation was seen associated with cerebral agenesis congenital short esophagus, a case of laryngo-tracheo-esophageal anomaly and postoperatively in a case of cardiospasm

9 Eight cases of postoperative tracheo-esophageal fistulas not reported here were discussed Several of these cases showed delayed evacuation of the lower segment of the esophagus and incoordinated peristaltic activity This suggests that dysphagia in this group is at least in part due to (*a*) congenital abnormality of the intrinsic nerve supply, (*b*) congenital abnormality of the extrinsic nerve supply, or (*c*) surgical disturbance of the esophageal autonomic plexuses during repair of the atresias and tracheo-esophageal communications

10 Radiographic examination, particularly fluoroscopy is necessary for diagnosis of defects of neuromuscular function The use of an indwelling tube through which lipiodol is placed into the esophagus for routine examination is to be discouraged The swallowing mechanism should be studied in its entirety

11 The otolaryngologist must be ready to diagnose neuropathological conditions causing dysphagia in addition to diagnosing physical anomalies

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NATIONAL SOCIETY MEETINGS

Schedule of Meetings for 1956

Eastern Section, to be held at the Statler Hotel, Boston, Mass , January 13

Middle Section, to be held at the Netherlands Plaza, Cincinnati, Ohio, January 16

Western Section, to be held at the County Medical Society Bldg , San Francisco, Calif , January 21

Southern Section, to be held at the Shamrock, Houston, Texas, January 27-28

American Board of Otolaryngology, to be held at the Sheraton-Mt Royal, Montreal, Canada, May 6-11

American Otological Society, Inc., to be held at the Seigniory Club, Montreal, Canada, May 11-12

American Laryngological Association to be held at the Seigniory Club Montreal, Canada May 13 14

American Broncho-Esophagological Association to be held at the Sheraton-Mt. Royal, Montreal, Canada, May 15 16, (afternoons)

The American Laryngological, Rhinological and Otological Society, Inc. will hold its Annual Meeting at the Sheraton Mt. Royal, Montreal, Canada, May 15 16 17 (mornings only)

Please make early plans to attend the 1956 Spring Meetings in Canada. Both the Seigniory Club and Montreal present most attractive features for you and your family More information about the places will be told to you

Reservations at the Sheraton-Mt. Royal Hotel should be made early by addressing the Reservation Supervisor, 1455 Peel Street, Montreal P Q Canada.

PHARYNGOESOPHAGEAL DIVERTICULUM AND THE TECHNIQUE OF ITS SURGICAL TREATMENT*†

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First, a word about terminology "hypopharyngeal" is a more correct adjective for these diverticula than "pharyngoesophageal" or "esophageal" We really prefer the term "hypopharyngeal diverticula," or "diverticula of the hypopharynx," but the terms "hypopharyngeal," or "esophageal," are so commonly employed that we used the term "pharyngoesophageal diverticulum" in the title of this paper

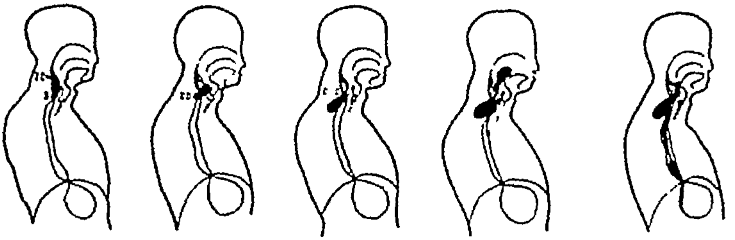

Fig 1 Schematic drawings showing the progressive enlargement of the common type of pulsion diverticulum of the hypopharynx (Zenker's) which begins as a herniation of the posterior hypopharyngeal wall at a congenital weak point in the musculature known as the space Lannier Hackerman (Drawings by Chevalier Jackson)

Etiology, we are not going to discuss (see Fig 1) In connection with *symptomatology* and *diagnosis* we will just mention briefly that the obvious symptoms are dysphagia and regurgitation, sometimes of very mild degree The diagnosis can be made in many cases by attention to the history, or by

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* Read at the meeting of the Eastern Section of the American Otological Rhinological and Laryngological Society Inc. Philadelphia Jan 7 1955

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a look at the hypopharynx with the mirror, because these patients practically all have an accumulation of frothy secretions in the pyriform sinuses which can be easily visualized If you note a little gurgle on squeezing the neck, and see some secretions in one or both pyriform sinuses, the diagnosis is made even before the X-ray is taken Roentgenray examination is the proper method to establish the diagnosis definitely, and it is important to demonstrate the neck of the sac and to show that the sac empties itself from the upper pole and not through the bottom (see Figs 2, 3 and 4)

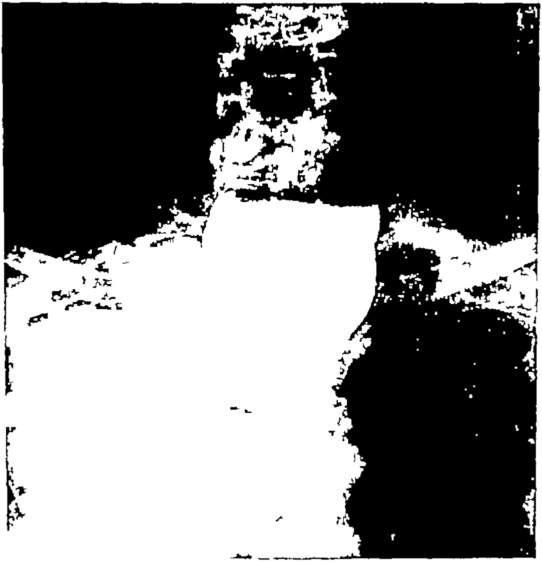

Fig 2. Roentgenogram of very large pulsion diverticulum one of series reported as successfully excised by the one stage technique (see Fig 3)

Esophagoscopy is not really absolutely necessary to confirm the diagnosis in most cases If you have typical X ray studies made by a good roentgenologist according to the proper technique, you can be 95 per cent sure that there is not a complicating stenosis or tumor present To be on the safe side, however, you are prefectly justified in confirming the diagnosis with a preoperative endoscopic examination

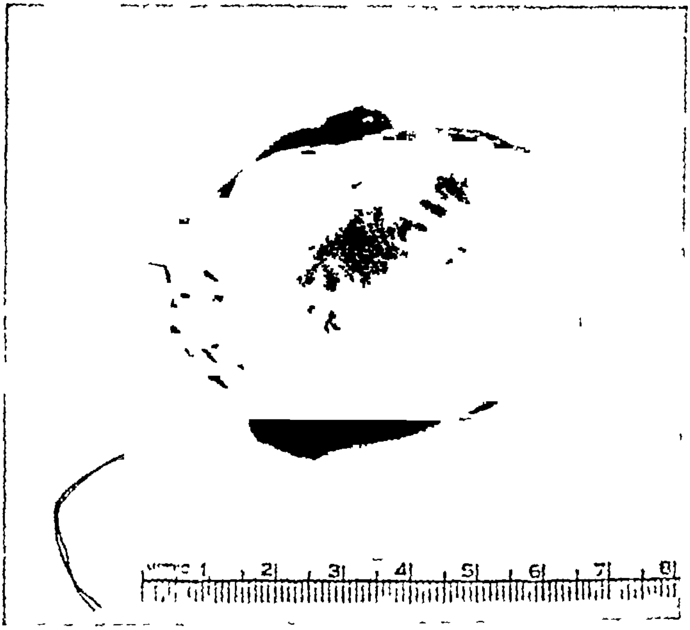

Fig 3 Photograph of surgical specimen—diverticulum of which preoperative roentgenray appearance is shown in Fig 2

TREATMENT

The earliest treatment advised for diverticulum sounds ridiculous now—surgical drainage At a later date, dilatation was used Dilatation may still have a place as a very conservative method in the cases where for some reason excision is contraindicated By dilatation we mean dilatation of the cricopharyngeal opening This must, of course, be done with the greatest care, to avoid perforation

Inversion of the sac has been described and advised, and has been used by some operators with success, the inversion accomplished either by external surgical or by endoscopic

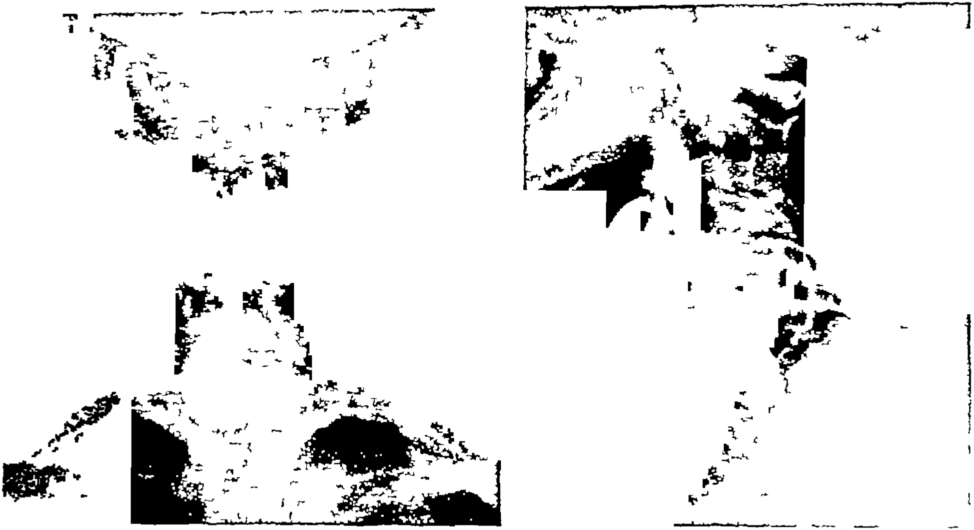

Fig. 4 Antero posterior and lateral roentgenograms showing clearly (in the lateral projection) the neck of a pulsion diverticulum of the hypopharynx This is an important diagnostic point—the sac must empty from the upper end otherwise the diverticulum is simulated by a dilatation proximal to stenosis.

approach We feel that the only really sound treatment is surgical amputation through an incision in the neck, and we feel that procedure is so well established now, that it is scarcely worth mentioning the other methods, except from a historical viewpoint.

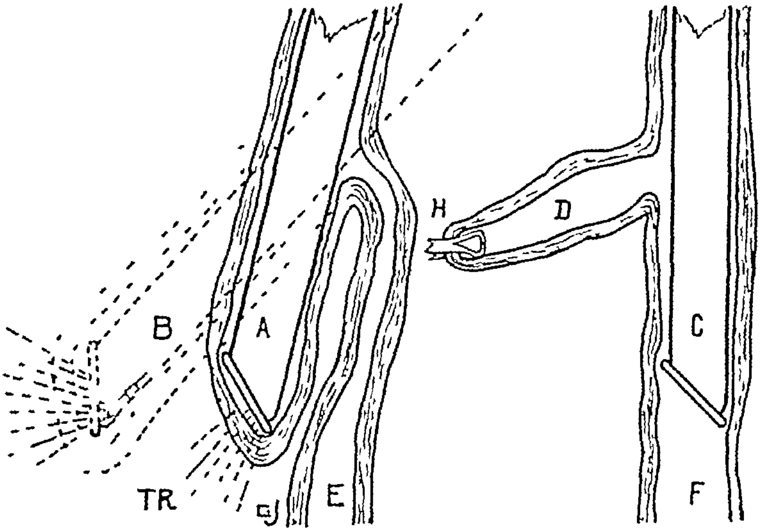

Fig 5 Schematic diagram of one-stage esophagoscopically guided operation

We have always been in favor of the one-stage rather than the two-stage operation The one-stage operation described by Otto Gaub[1] and Chevalier Jackson, then in Pittsburgh (1915), has stood the test of time, and is still good with only minor modifications (see Fig 5) Among the surgeons who have had large experience and contributed to the development of the technique should be mentioned, Shallow[2,3] and Babcock[4,5] in Philadelphia Lahey[6,7] of course, was always very much interested in this condition but always preferred the two-stage operation Perhaps his argument in favor of the two-stage procedure had more foundation in the past than they have today, but since the advent of the antibiotics most operators have come to agree that the one-stage procedure is preferable Sweet,[8] in Boston, and McNealy,[9] in Chicago, are among those who have contributed to the development of the surgical technique

CLINICAL EXPERIENCE

The present paper has as its justification not this sketchy review of the history of the subject, but the very concise presentation of the experience we have had in the past ten years in 75 patients Of those patients we are reporting on the 53 on whom operation was done

Of these 53 operated patients, 38 were males and 15 females It is rather interesting to note the tremendous predominance of males in this series The average age was 57 I think that is an interesting figure also, because we always think of diverticulum as a condition affecting elderly people The youngest patients were in their twenties—21 and 27, the oldest was a man of 80, nineteen of them were over 60 and 8 were in their seventies

The duration of symptoms varied from a few months to many years Three of our patients had previously been operated upon by others, the remaining 50 were operated upon for the first time We used a one-stage technique in all but two instances In these two cases, for certain reasons, the operation was done in two stages

In most cases we used the esophagoscope in one way or another We always had it at hand According to the classic esophagoscopically guided technique, you first introduce the scope into the sac and aspirate its contents, confirming identification by transillumination, and then you withdraw it and pass it into the esophagus, to make sure that you amputate the neck at the proper point without taking off either too much or too little We did not use the esophagoscope in all cases. In most cases we used it to demonstrate the continuity of the esophagus before amputating the sac. The surgeon with some experience in this particular operation very rarely needs to confirm the identity of the sac by transillumination. The smaller the sac is the more difficult may its identification be, and the more important the aid of the esophagoscope After you have seen a certain number of diverticula it is generally not difficult to differentiate the pouch from the left lobe of the thyroid gland but the less experienced operator may mistake that structure for the pouch

If the esophagoscope is used, the patient should swallow a string a day or two before operation, because when you have a patient on the operating table, regardless of the type of anesthesia used, it is difficult to posture the head and neck just right for introduction of the scope into the subdiverticular esophagus It is difficult in the presence of a diverticulum anyway, to get a scope into the esophagus, because it always tends to go into the sac

SURGICAL TECHNIQUE

We have reviewed the surgical technique as described in the reports of operation in this whole series, and have the following observations to make For anesthesia we found avertin quite satisfactory previously, but in the past several years we have found intratracheal anesthesia combined with intravenous pentothal much better, and this was the anesthetic used in more than half of our cases Cervical block has been used in a few cases, and if you have someone to do the cervical block better than the available personnel can do the endotracheal anesthesia, then cervical block should be considered, however, we really find the relaxation that is obtained with endotracheal anesthesia very desirable, and believe it preferable

The incision we used in most of our cases was a diagonal one, an incision along the anterior border of the left sternomastoid muscle Some have advocated a transverse incision for cosmetic reasons We think an incision in the groove anterior to the sternomastoid muscle is just as satisfactory from the cosmetic viewpoint, and gives a little better approach for locating the sac

If you go down by blunt dissection and locate the omohyoid muscle, always mentioned in descriptions of the surgical approach to the cervical esophagus, though usually thin and of little importance, this muscle is either divided or retracted As you approach the esophagus by blunt dissection, retracting the left lobe of the thyroid gland medially, you pick up the sac with visceral forceps and draw it out into the wound, freeing it by blunt dissection

Transillumination with the esophagoscope is the sure proof that you have located the sac, and has the additional advantage of permitting aspiration of its contents The esophagoscope is introduced over the string and guide sutures inserted at the upper and lower poles of the sac After placing those sutures, the scope is withdrawn, because one of the faults found with the esophagoscopically guided technique is that with the scope in the esophagus the neck of the pouch is held deep in the wound, making it difficult to accomplish the amputation and closure If the scope is withdrawn after placement of the guide sutures, then the sac can be drawn out in the wound, the neck amputated and the closure performed with ease (see Fig 6)

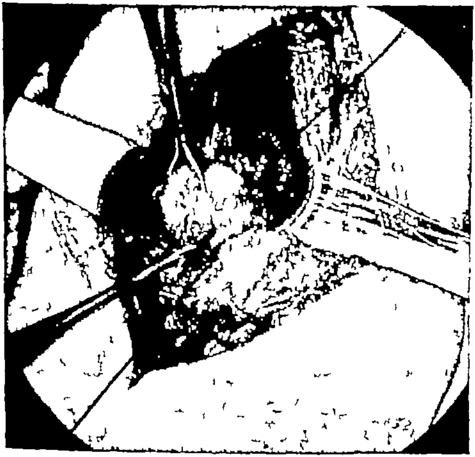

Fig 6 Single stage diverticulectomy The sac is drawn out with visceral forceps and guide sutures of black silk have been placed at the upper and lower margins of its neck The sac can now be amputated and the neck closed with a follow up "whipover" suture

Now, as to the technique of this amputation, we have used various methods We formerly used almost always, a clamp on the neck of the sac, and did the amputation below that, closing the neck progressively as we continued the amputation We have been using the clamp less recently, however, and generally just incise the neck and follow up with a continuous suture of No 000 chromic catgut on an atraumatic needle

There has been a good deal of discussion about the proper technique of closure We find a simple "whipover" stitch very satisfactory, uniting the edges and not necessarily inverting them, the accurate approximation obtained with the use of an atraumatic needle on fine catgut gives a very good closure Several years ago Furstenberg[10] read a paper on diverticulum before a Sectional meeting of the "Triological" Society, and he contrasted the Cushing type of suture with the whipover suture in closure of the neck, expressing his preference for the whipover We agree with that, but we do not then make a "pursestring" of it, as Furstenberg describes The reason we do not make a "pursestring" tie by uniting the ends of the suture at the completion of the closure is that a number of surgeons, McNealy and Sweet among them, have advised against the use of the pursestring closure in this operation We use a second continuous suture of the same sort, inverting with the second row and then closing over the muscles with interrupted sutures of the same material, introducing a small No 12 rubber catheter down almost to the line of closure for drainage, and closing the skin with interrupted and continuous sutures of No 35 alloy steel wire

POSTOPERATIVE CARE

The feeding tube is left in place for eight or nine days, checking with barium before it is removed, to see that there is no leakage out into the tissues If there is such leakage, we wait a few more days before removing the tube The administration of procaine penicillin, 300,000 units twice a day until the tube is removed, is routine Tube feedings are given every two hours for the first day or so, consisting of three or four ounces of strained fruit juice, alternated with high protein eggnog

RESULTS

In the 53 cases there was one postoperative death, the cause was embolus or cardiac failure, but the last 50 consecutive cases have been without mortality The average period of hospitalization was 14 days, but six of the patients were out in from 10 to 13 days, several were out in ten days several in 11 days, and six in between 10 and 13 days Only seven patients were in the hospital over three weeks These included the patients operated upon in two stages, and one who developed a flare-up of urinary tract infection that had nothing to do with the diverticulectomy Three of our patients had been previously operated by others As we mentioned in the beginning, none of our series have yet required a second operation as far as we know, though several are known to have small residual pouches which are asymptomatic.

COMPLICATIONS

There was one case of stenosis that required several esophagoscopic dilatations, but now, several years after operation, this patient has no trouble whatever and no persisting stenosis This was one of the cases in which we did not use esophagoscopic guidance in determining amputation and closure. In six cases there was at least a temporary left recurrent laryngeal paralysis though several of these have recovered motion of the cord In one case there was a preoperative left recurrent laryngeal paralysis, possibly due to the diverticulum, possibly to other causes In one case there was delayed wound infection of no serious consequence (not mediastinal) developing a week or ten days after operation but subsiding quickly after drainage As already mentioned, in one case there was a flare-up of urinary tract infection

In conclusion, a series of 75 cases of diverticulum of the hypopharynx, so-called pharyngoesophageal diverticulum, in 53 of which operation was done by the authors during the past ten years is reported The authors believe that their experience reconfirms the value of the one-stage esophagoscopically guided operation

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THE SURGICAL TREATMENT OF CANCER OF THE PARANASAL SINUSES *†

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Generally speaking—surgery, until recently, has aroused little enthusiasm as the primary or principal method of treatment for cancer of the paranasal sinuses Such operations have always been considered difficult and fraught with considerable hazard to the patient. Formerly, the operative mortality was high, and complications due to faulty anesthesia, shock, blood loss, and infection were often severe moreover, surgical attempts at removal of cancer in this region are never entirely satisfactory since, although resection of the entire maxillary antrum is possible, removal of the frontal, ethmoid and sphenoid sinuses is never complete To many surgeons, the mutilating aspects of such surgery, especially when exenteration of the orbital contents seems indicated, is a deterring factor In most clinics, therefore, surgery for cancer of the paranasal sinuses has been of the electro-cautery variety and limited to post-irradiation drainage, sequestrectomy, or exposing the area for radium implantation

Reports in the literature indicate that irradiation, either alone or in combination with surgery, has been the primary treatment method of choice for many years It was considered less radical and was supposed to circumvent some of the obvious disadvantages of surgery Since it never completely satisfied these two objectives its choice appears to have been more by default rather than by proved superiority of results Unfortunately, this method of treatment has serious disadvantages When delivered in adequate doses, irradiation is prone to produce severe ocular complications which in many instances leads to loss of the eye Edema of the mucosa of the sinuses plus obstruction of normal drainage channels by in-

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fected and necrotic cancer leads to pansinusitis, suppuration, and sepsis, thus, disability is often prolonged for weeks and months Although destruction of the tumor by irradiation is sometimes complete, the eventual wide surgical drainage and sequestrectomy is often of such magnitude that in many cases radical surgery might as well have been employed initially

Experiences in our clinic and elsewhere have shown that irradiation, when employed as the sole or chief method of treatment, has produced few cures of cancer of the paranasal sinuses Vastly improved results, however, have been achieved when irradiation and surgery have been employed together in varying combinations The most popular of these combinations has been that of heavy external irradiation followed by electro-cautery excision It is our belief that more emphasis should be placed on surgery initially and that irradiation should be reserved for postoperative use in the advanced unfavorable case or where there is clinical evidence of residual or recurrent disease Such primary surgery is facilitated by recent improvements in anesthesia, adequate blood replacement and the universal availability of the sulfonamides and antibiotics Due to these modern surgical aids substantial progress has been made in the surgical attack on these neoplasms during the last two decades, and the reduction in operative mortality and serious complications has been impressive

The discovery that skin grafting can be successfully employed to cover the operative defect reduces postoperative morbidity and facilitates early application of a satisfactory dental prosthesis

Meningitis and brain abscess, always a severe threat to the patient in former years, are now rare complications There is also reason to believe that there has been a significant improvement in the overall salvage rate of patients with cancer of the paranasal sinuses Many favorable cases are apparently cured by surgery alone while in others more accurate and efficient postoperative irradiation is possible with corresponding diminution of distressing complications

ANATOMIC CONSIDERATIONS

Despite the encouragement due to improvements in surgical technique, cancer of the paranasal sinuses remains a highly lethal disease and its treatment is one of the most difficult encountered in the head and neck region The continued high mortality can be attributed mostly to the complex anatomy of the nasal cavity and accessory sinuses which makes early diagnosis of these neoplasms almost impossible

Cancer arising in the accessory sinuses is rarely confined to a single set of air cells at the time of diagnosis, so that accurate classification of the exact anatomic site of origin in some cases may be difficult or impossible. In the case of lesions arising in the floor or lateral wall of the antrum, a bulging mass may present in the mouth or cheek so that the probable site of origin may be relatively easy to determine If the mesial wall of the antrum is involved, erosion of the nasal party wall and extension into the nasal cavity, ethmoid and sphenoid cells and orbit is common The same degree of involvement may be seen in lesions which are primary in the ethmoid sinuses It appears that without surgical exploration, the extent and exact origin of tumors of the paranasal sinuses is largely a matter of conjecture Even at operation, one may be unable to make detailed anatomic classification due to widespread involvement Classification of these tumors, while de sirable in the interest of statistical analysis, accuracy of observations and prognosis, is of limited value from the surgical viewpoint. Practically speaking, there is little variation in the surgical approach to cancer of the paranasal sinuses and nasal cavity since the basic operation entails resection of the maxilla with curettage of the other sinuses

Despite the difficulties enumerated we attempt to classify all tumors of the paranasal sinuses and nasal cavity In our experience approximately one-third of the cancers of this region apparently arise within the nasal cavity Tumors, pri mary in the maxillary antrum, are six or seven times more frequent than those arising in the ethmoid cells A point of interest is that cancer is rarely demonstrated to have arisen primarily in the frontal or sphenoid sinuses though these air cells are frequently involved secondarily This is possibly of some etiological significance since these latter areas show a lessened incidence of inflammatory conditions

SIGNS AND SYMPTOMS

Depending upon the anatomic site of origin of the neoplasm, numerous signs and symptoms may be said to be diagnostic of cancer of the paranasal sinuses These include local pain, swelling over the malar region, lacrimation, displacement of the orbital contents, nasal obstruction and discharge These symptoms are not peculiar to cancer alone, and it should be pointed out that when associated with cancer of this region, are usually indicative of advanced disease Cancer of the paranasal sinuses rarely produces serious symptoms in its early stages and is usually apparent only after erosion of bone with extension into the nasal cavity, orbit, or soft parts of the cheek Confusion with inflammatory conditions may occur since many patients give a history suggesting this diagnosis Unfortunately, routine radiographic studies may be of limited value in confirming the diagnosis of cancer until late in the course of the disease The discrepancy between radiographic and surgical findings is often marked, since at operation one commonly finds extensive involvement of more than one of the sinuses in addition to the nasal cavity

PATHOLOGY

The paranasal sinuses may be involved either by tumors arising primarily within the air cells themselves or by secondary invasion from tumors originating within the nasal cavity, orbit or mouth Primary malignant bone tumors of the skull may also encroach on the paranasal sinuses and long-standing and deeply ulcerated skin tumors, on occasion, invade them Although the diagnostic problems and surgical approach may be essentially the same, the term cancer of the paranasal sinuses, as used in this connection, refers to those tumors arising from the mucous membrane lining these structures It follows, therefore, that the usual histologic picture of these tumors is that of squamous or epidermoid cancer The grading may vary from low-grade to highly anaplastic tumors Adenocarcinoma, when found here, is usually described as adenoidcystic or mucoepidermoid cancer and has its origin in the innumerable minute mucous secreting glands located in the lining epithelium of the upper air passages Other less frequent tumors encountered include lymphosarcoma, connective tissue sarcomas, extra medullary plasma cytomas and melanoma.

OPERATIVE TECHNIQUE

Once a diagnosis of cancer of the nasal cavity or the paranasal sinuses is established, it is our belief that radical surgical treatment is indicated Minor procedures such as trans nasal polypectomy, lateral rhinotomy and the Caldwell Luc operation, are inadequate for the treatment of cancer As previously noted, the extent of the disease is almost invariably

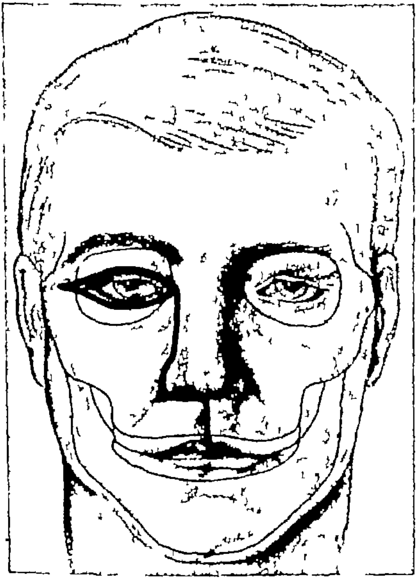

Fig 1 Resection of the maxillary bone requires wide exposure. The Weber Ferguson incision is adequate in this respect, and is desirable from the cosmetic point of view The horizontal limbs of the incision should be placed within a few mms of the palpebral margins Should the orbital contents be spared the upper limb is omitted.

greater than suggested by either clinical signs or radiographic studies Since this means that the nasal cavity and adjacent sinuses are usually filled with necrotic and infected tumor, wide surgical drainage is in order This is best accomplished by resection of the maxilla and curettage of the adjacent areas Prompt relief from sepsis and pain can thereby be expected It should be pointed out that routine entry of the frontal sinus is not required due to its infrequent involvement by cancer The principal steps in the operative treatment of cancer of the paranasal sinuses are best described in the accompanying illustrations

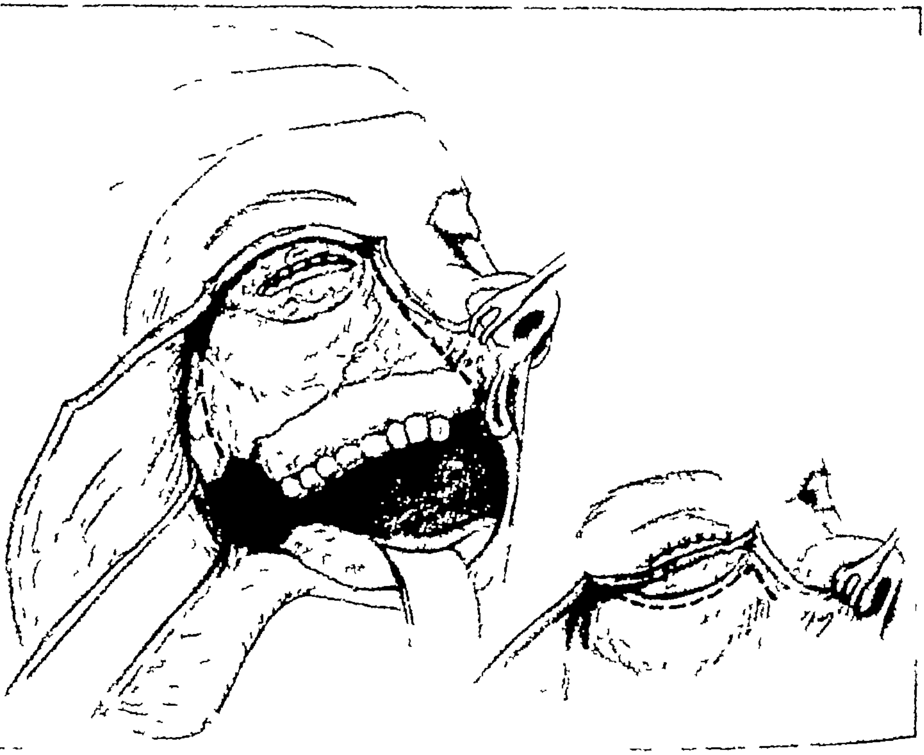

Fig 2 Reflection of the cheek flaps exposes the entire anterior surface of the maxillary antrum and provides direct access to the nasal cavity The bony attachments are divided by motor driven saw and a hammer and chisel The saw lessens chances of fracture when the infra orbital ridge is to be preserved

The question of exenteration of the orbit, as a part of the initial surgical procedure, warrants some discussion To some, sacrifice of an otherwise normal eye during the course of radical surgical attempt at cure of sinus cancer may seem unnecessarily mutilating In this connection it should be noted that in many cases the eye is ultimately lost as a result of complications of irradiation or extension of the tumor The decision as to whether or not the eye can be spared is often difficult and in some cases must be delayed until the time of surgery Should the disease arise in the floor of the maxillary antrum and its principal direction of invasion be downward, preservation of the infraorbital ridge and orbital contents may be practical and relatively safe Removal of the bony floor of the orbit, however, without removal of the eye may

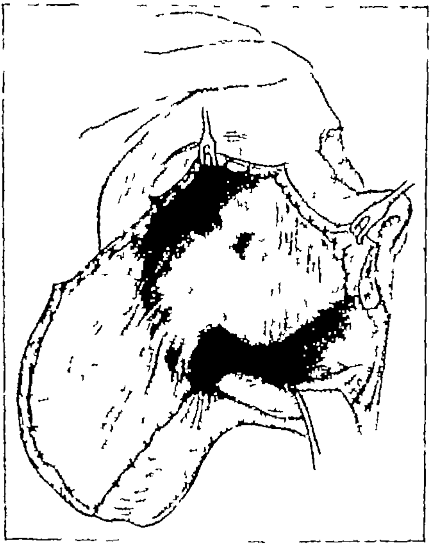

Fig 3 Complete resection of the maxilla includes removal of the mesial wall and the structures of the adjacent nasal cavity This is followed by thorough curettage of the sphenoid and ethmoid sinuses

lead to troublesome diplopia In those cases where there is obvious destruction of the inferior or mesial walls of the orbit, it is usually in the best interests of the patient to sacrifice the eye By so doing one may materially increase the margin of excision about the growth and facilitate accurate observation during the postoperative period Such a clinical setting is usually seen where there is extensive involvement of the ethmoid sinuses

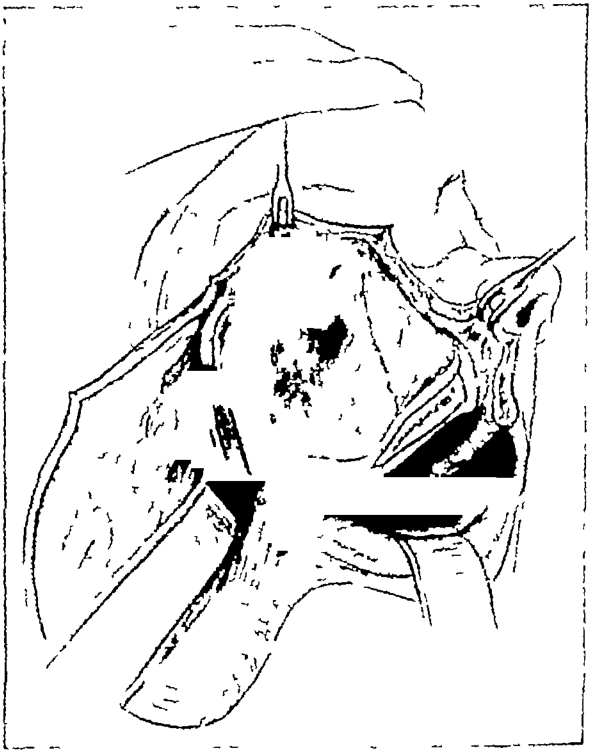

Fig 4 The entire operative area is lined with a split thickness graft which is anchored in place with multiple sutures The cavity is then firmly packed with gauze to provide adequate pressure The long ends of the sutures (not shown) are useful to tie over and anchor the pack

Erosion of the base of the skull in the region of the cribriform plates does not necessarily indicate a hopeless prognosis Portions of this bone are often removed during the course of curettage of the ethmoid area Although this inevitably results in rents of the dura and leakage of cerebrospinal fluid, this is no longer considered a major hazard Meningitis and brain abscess are uncommon complications when sulfonamides, antibiotics and skin grafting are employed

The discovery that split thickness skin grafts may be successfully used to line the operative defect is, in our opinion one of the major advances in the surgical treatment of cancer of the paranasal sinuses If the removal of mucous membrane from the bony surfaces is complete, such grafts have been demonstrated to survive equally well on the cheek flap, bare bone dura, or cerebral cortex Such grafts, when reinforced by a firm pack, promptly seal rents of the dura and probably contribute to the low incidence of brain herniation, moreover, in the healed state, they provide a clean and dry cavity which is free of troublesome granulation and polyp formations Thus early fitting of a dental prosthesis is possible and postoperative morbidity is materially shortened

PROGNOSIS AND END RESULTS OF TREATMENT

Since cancer of the paranasal sinuses is rarely diagnosed early, it is uncommon to find the disease confined to a single structure In the average case, erosion of bone and invasion of neighboring areas is present when the patient first applies for treatment. The disease, therefore, is usually advanced at the time of diagnosis, and the prognosis is largely dependent on the degree and direction of spread Cancer of the maxillary antrum in which the direction of growth is largely downward or outward with infiltration of the superior alveolus or hard palate, without involvement of other structures, may offer a relatively favorable outlook for radical extirpation and cure If, on the other hand, the direction of spread is mesialward and superiorly in the direction of the nasal cavity, ethmoids, orbit, base of skull etc., the prospects of cure by any method of treatment are unfavorable, nevertheless radical surgery followed by intensive irradiation offers hope for permanent control of the disease in some cases and worth while palliation in others The results of treatment of cancer of the paranasal sinus, regardless of the method of treatment, are often poor and usually mutilating

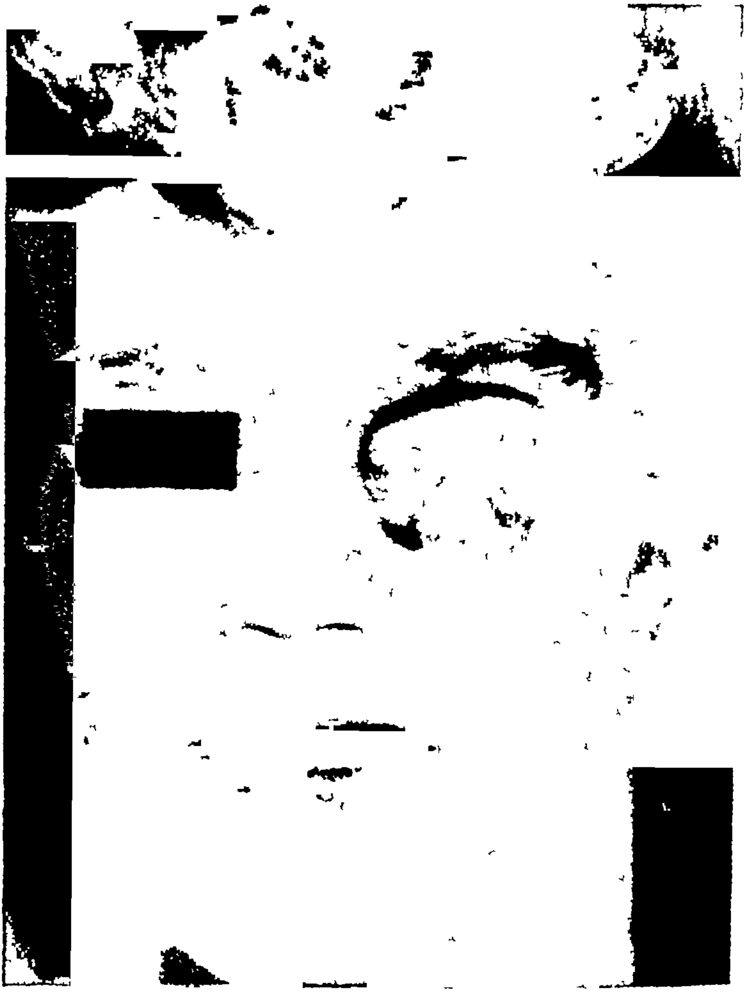

Fig 5 In the healed state the operative incisions are no longer visible Note the appearance of the skin graft three years following surgery

The literature contains relatively few reports[1-3] of the results of treatment of significant numbers of patients with cancer of the paranasal sinuses Comparative results of treatment are somewhat difficult to assess since not all reports are based on total experience with the disease Recent statistics compiled on the Head and Neck Service of the Memorial Hospital[4] indicate a five-year cure rate of 22 5 per cent based on 173 determinate cases treated during the years 1935-

1947 These patients were mostly treated by a combination of surgery and irradiation Primary emphasis was placed on irradiation, with surgery playing a secondary role, during the earlier years, while more recently this emphasis has been reversed Patients with epidermoid cancer of the maxillary antrum showed a five-year cure rate of 15 0 per cent when treated principally by irradiation as contrasted to 30 0 per cent five-year cures during the latter years of this experience when surgery was the principal or primary mode of treatment A similar but less spectacular improvement (20 0 versus 33 0 per cent) was seen in the cures of patients with epidermoid cancer of the ethmoid sinuses This latter series was small and possibly not statistically significant.

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TWO-MILLION-VOLT RADIATION FOR TREATMENT OF MALIGNANCY OF THE HEAD AND NECK[*]

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This is a preliminary report of the management of malignancy of the head and neck in which the principal method of treatment was radiation with two-million-volt Roentgen rays It is not a statistical report of five-year survivals because supervoltage radiation therapy of this magnitude was first begun at the Lahey Clinic just over five years ago, and, consequently, there is insufficient material to present such an analysis This presentation is comprised of 171 patients followed concurrently by the Departments of Radiology and Otolaryngology of The Lahey Clinic from the latter part of 1949 through 1954 (see Table I)

Two-million-volt radiation therapy was administered to the patients comprising this series because the size and extent of the local lesion, or the presence of metastases, was considered to militate against adequate surgical removal, recurrence had taken place following previous surgical excision, the patient desired radiation rather than surgical therapy, or the lesion was one in which the commonly accepted form of treatment is Roentgen therapy Hodgkin's disease and malignancy of

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the thyroid gland are not included in this study, as the progress of such patients after radiation usually is not followed by an otolaryngologist. Surgical intervention, radiation therapy, or both, prior to treatment by two-million volt Roentgen rays, had been unsuccessful in 34.5 per cent of the patients.

TABLE I.
MALIGNANCY OF THE HEAD AND NECK

Year Treated	1949	1950	1951	1952	1953	1954	Total
No. Patients	7	23	31	35	43	33	171
Alive	4	14	17	18	28	26	107

These patients were treated with X-rays generated at 2 mev. using a Van DeGraaff generator. This radiation is physically equivalent to the Gamma rays of radium and of radioactive cobalt. Their half-value layer is equal to about 13 mm. of copper.

The advantages of using 2 mev. X-rays in comparison to 200 kv. X-rays are as follows. First, the dose necessary to produce a threshold erythema of the skin with 200 kv. X-rays in a single exposure is between 450 and 550 *r*, and with 2 mev. this dose will be between 1400 and 1600 *r*. With 200 kv. X-rays in fractionated doses of 300 *r* daily, the skin erythema dose will be under 1000 *r*, and with 2 mev. X-rays, fractionating at the rate of 300 *r* skin dose daily, the first erythema will occur between 3000 and 4000 *r*. The skin, therefore, with 2 mev. X-rays is a minimal problem. Second, increased penetration with 2 mev. X-rays gives a more effective depth dose. For example, with 200 kv. and a 100 sq. cm. field, the dose 10 cm. deep in tissue will be 32 per cent of the dose at the surface, whereas with 2 mev. X-rays using the same field size the 10 cm. depth dose at the same 50 cm. target skin distance will be 52 per cent of the dose at the surface. Third, with increasing voltage there is an increase in X-ray output and a greater tendency for the generated X-rays to be propagated in the forward pattern. This results in a far higher X-ray dosage rate and permits the use of longer treatment distances and shorter treatment times. With the 2 mev. X-ray treatments referred to herein, a 125 cm. target-to-skin distance was used The inherently lower scattering of 2 mev radiation maintains a more sharply defined beam even in depth of tissue, and this high energy radiation is not selectively absorbed in bone, as with conventional radiation

Both rotational and stationary techniques of irradiation are used Rotational irradiation may be regarded as the use of an infinite number of cross-firing stationary portals If a square or rectangular field is rotated, the resultant continuously irradiated volume takes the shape of a cylinder, if the field is round, the resultant irradiated volume is a sphere The machine is stationary in our set-up, and the patient does the rotating at the slow rate of about one revolution per minute

The cases of intrinsic laryngeal lesions are treated rotationally with a 4 x 4 cm field with a resulting 4 cm cylinder volume of irradiation in tissue centered on the true cords, to a total tumor dose of 6000 *r*

Patients who have extrinsic laryngeal tumors with or without involved nodes, and those with intrinsic laryngeal tumors with nodes, are treated with a cylinder that includes the entire neck to just below the clavicles for a tumor dose of 6000 *r* In several cases involving the base of the tongue we have supplemented the primary lesion with a small field to a dose of 7500 *r* In a few cases of lesions in the floor of the mouth and base of the tongue we have limited irradiation to the primary site when no nodes were present and the grade of malignancy was low Some have been treated by rotation with resultant cylinders of irradiated areas and some by opposing fields only

Treatment of the nasopharynx requires two fields the actual nasopharynx and oropharynx are treated by lateral opposing fields shaped to include the necessary regions of lymphatic drainage, the second part of the field includes the cervical, supraclavicular and superior mediastinal areas in one large field with the radiation being given by opposing anterior and posterior fields The plane of junction of these two fields is carefully marked and matched, and this junction is protected from overdosage or underdosage by staggering its location by 2 to 3 cm daily The dosage for nasopharyngeal tumors is carried to 6000 *r* Patients with laryngeal and extralaryngeal involvement receive a minimum of 6000 r As stated previously, in cases in which the tongue is involved we have attempted to give 7500 r to the primary tumor if possible

From the clinician's viewpoint, the most distinctive characteristic of the treatment of malignant tumors of the head and neck with supervoltage radiations of two-million volts as compared to conventional deep Roentgen therapy of 250 to 400 kv is the relative ease with which the patient tolerates treatment. A number of the patients continued to carry on their work during the major portion or all of the period of treatment when their residence and place of employment were so located that they could take off sufficient time from work each day to receive Roentgen therapy The reaction of the skin to higher doses of 2000 kv radiation was considerably less than that observed with conventional deep Roentgen therapy Only on occasion was a weeping and desquamating Roentgen dermatitis encountered and, when it did occur, it subsided rapidly following completion of the Roentgen therapy In only one instance, to my knowledge, did radionecrosis of the skin occur This patient had an epidermoid carcinoma Grade I, of the external auditory canal and middle ear and had received supervoltage radiation on two occasions approximately 14 months apart

The reaction of the mucous membrane of the nose mouth and pharynx to two-million-volt radiation did not appear to be as intense as that commonly observed with conventional deep Roentgen therapy Ulceration and necrosis were observed not infrequently when the lesion was situated in the tonsil area or the hypopharynx, and probably occurred as a result of a combination of the regression of the lesion secondary infection and radiation

The majority of the patients were able to maintain their nutritional requirements fairly satisfactorily while receiving treatment. Almost all lost weight to some degree however, which they attributed to decreased appetite because food seemed tasteless, or to increased difficulty in mastication of food as a result of dryness of the mouth and throat A few patients required hospitalization near the end of their course of Roentgen therapy in order to supplement their caloric intake with intravenous feedings and to obtain relief of pain on swallowing This occurred most frequently among those patients who had malignant involvement of the hypopharyngeal region

When it was found necessary to employ surgery following a single course of radiation therapy in an effort to eradicate persistent or recurrent neoplastic disease, less difficulty was encountered post-operatively The patient usually withstood the operative procedure better, the time required for the wound to heal, although usually longer than in a patient not exposed to radiation, proceeded in a satisfactory manner and fewer complications developed This probably was because the nutrition of the patient was better, and the skin reaction was less severe than with conventional deep Roentgen ray therapy When fistula formation or other evidences of improper healing did develop, they responded quite satisfactorily to additional operative procedures, however, when the patient had received more than one course of Roentgen therapy and when the fields of radiation overlapped to some extent so that some tissue through which the operation was to be performed received more than the usual amount of radiation, less satisfactory healing occurred Under such circumstances the use of split thickness grafts, delayed rotation flaps or tubed pedicle grafts occasionally were necessary to effect healing of the wound

There were six patients with malignant disease involving the middle ear in this group of 171 patients (see Table II)

TABLE II
MALIGNANCY OF THE MIDDLE EAR

Year Treated	1949	1950	1951	1952	1953	1954	Total
No Patients	0	0	2	0	2	2	6
Alive ..	0	0	1	0	1	2	4

The pathologic diagnosis was epidermoid carcinoma in two, adenocarcinoma in three, and glomus jugularis in one The glomus jugularis was an extensive neoplasm which blocked the external auditory canal, extended into the neck and involved the mastoid process, the middle ear, and petrous pyramid as well as the immediately adjacent bone of the base of the skull A neoplastic involvement of this extent when the common carotid artery cannot be sacrificed is obviously inoperable and, therefore, the patient was treated by supervoltage Roentgen therapy alone The remaining patients were treated by a combination of surgery and two-million-volt Roentgen rays

The carcinoma of the external auditory canal and middle ear was thought to have been adequately eradicated by an extensive radical mastoidectomy in the first patient of this latter group, only to have recurrence and extension of the tumor develop within a year, which failed to respond to Roentgen therapy, therefore, the next patient was given supervoltage radiation, administered through a narrow field, as soon as possible after radical mastoidectomy Metastasis to the parotid lymph nodes was present in approximately one year Another course of two-million volt radiation was directed to the area through a larger field This resulted in extensive radionecrosis which required extensive surgical resection of the necrotic area and plastic surgery to afford skin cover This unfortunate occurrence had its fortuitous aspect, however, for it suggested to us that wider surgical excision of bone might be desirable from a clinical standpoint, consequently the remaining patients with carcinoma of the middle ear have been treated by surgical excision of the mastoid process, base of the petrous pyramid, and immediately adjacent squama of the temporal bone commensurate with the disease present.

Four of the six patients with malignant disease of the middle ear are alive. The patient with the extensive glomus jugularis continues to improve clinically, although tumor tissue probably still persists but has remained in abeyance during the past nine months The remaining three patients had carcinoma of the middle ear with dural involvement and have been clinically free of malignant disease for ten 28 and 40 months.

Thirty-one patients with malignancy of the nasopharynx have received two-million-volt radiation therapy (see Table III) The pathologic diagnosis was epidermoid carcinoma in 18 patients undifferentiated carcinoma in five, adenocarcinoma in four lymphoepithelioma in two transitional cell carcinoma in one, carcinoma simplex in one reticulum cell sarcoma in one, lymphosarcoma in one, fibrosarcoma in one, chordoma in one and malignant chromophobe pituitary adenoma in one The majority of the patients presented evidence of metastatic disease which, as is well known, all too frequently is the first manifestation of nasopharyngeal malignancy The commonest location for such metastases is the cervical lymph nodes, and this was true of 18 patients in this group Erosion of the base of the skull was present in seven patients

TABLE III
MALIGNANCY OF THE NASOPHARYNX

Year Treated	1949	1950	1951	1952	1953	1954	Total
No Patients	1	4	7	5	6	8	31
Alive	1	3	3	2	5	6	20

Twenty of the 31 patients are alive and 11 are dead Seventeen of the 20 patients who are alive are clinically free of disease One patient has recurrent ulceration of the nasopharynx which may be the result of excessive radiation, since he had been given radiation therapy elsewhere prior to being treated at the clinic. Another presents questionable persistent disease, and the third patient, whose pathologic diagnosis was reticulum cell sarcoma, exhibits persistence and extension of the neoplasm

Of the 20 patients who are alive, one received supervoltage radiation therapy in 1949, three in 1950, three in 1951, two in 1952, five in 1953, and six in 1954 Five of the 31 patients with malignant disease of the nasopharynx had received radiation therapy in one form or another before they were given two-million-volt Roentgen therapy, and of these two are alive and well although one has recurrent ulceration of the nasopharynx The remaining three patients are dead Four of the 31 patients received supervoltage radiation on two occasions and, of these, only one is alive and apparently free of disease The average survival time of the patients who died was eight months Only one patient was treated five years ago, and she is alive and clinically free of disease

Carcinoma of the larynx was present in 42 of the 171 patients in this series (see Table IV) A number of the patients had been advised to have total laryngectomy but elected to have radiation therapy instead Ten of the 42 patients had cervical metastases Surgical excision of the neoplasm with recurrence of the carcinoma before administration of two-million volt radiation therapy had been performed in nine or 21 per cent, of the 42 patients Total laryngectomy had been performed in five patients and of these, two subsequently had required radical neck dissection for metastatic disease, which in one instance was bilateral and in the other the disease had recurred Two patients had unilateral radical neck dissection concomitant with total laryngectomy, and the remaining two patients, who had postcricoidal carcinoma, had been subjected to total laryngectomy, pharyngectomy and unilateral radical neck dissection

TABLE IV

MALIGNANCY OF THE LARYNX

Year Treated	1949	1950	1951	1952	1953	1954	Total
No Patients	2	8	8	6	12	6	42
Alive	2	6	7	5	12	6	38*

*Six of these had postradiation surgery

Two-million volt Roentgen ray therapy was administered to two patients in 1949, eight in 1950, eight in 1951, six in 1952, 12 in 1953, and six in 1954 Thirty-eight of the 42 patients are alive and four are dead One of the patients who is alive has radionecrosis of the hypopharynx and persistence of disease following two courses of supervoltage radiation, another has questionable recurrence and six required total laryngectomy following radiation for persistent or recurrent disease One patient who had radiation for recurrent disease following excision of a postcricoid carcinoma and who does not now exhibit evidence of recurrence, has mild postradiation changes of the spinal cord which do not prevent her working Thus, 30 patients are alive and without evidence of recurrent disease following two-million-volt radiation treatment of the original lesion or of recurrent disease of the larynx. One patient received treatment in 1949, five patients in 1950, six in 1951, four in 1952 10 in 1953, and four in 1954 All six patients who required total laryngectomy for recurrent disease following supervoltage radiation are alive and well The average survival time of those who died was eight months Two patients were treated five years ago, and both are alive and without evidence of disease, although one required a total laryngectomy for recurrent disease 56 months after beginning radiation therapy

For the purpose of this study, all patients who had malignant disease of the floor of the mouth, the tonsil or base of the tongue and the hypopharynx were considered as a group (see Table V) There were no instances of carcinoma of the anterior third of the tongue among these, and of these patients with malignancy of the tonsil, in almost every instance the immediately adjacent tongue was involved There were 59 patients in this group 18, or 30 per cent, had had previous surgical intervention, radiation therapy in one form or another, or both, without success before they were given two-million-volt radiation therapy The pathological diagnosis was epidermoid carcinoma in 46 patients, squamous cell carcinoma in three, undifferentiated carcinoma in two, fibrosarcoma in two, and in the six remaining cases the diagnosis was adenocarcinoma, lymphosarcoma, reticulum cell sarcoma, rhabdomyosarcoma, mixed epidermoid carcinoma and fibrosarcoma, respectively Metastases to the cervical lymph glands were present in 34 of the patients

TABLE V

MALIGNANCY OF THE FLOOR OF THE MOUTH, TONGUE TONSIL OR HYPOPHARYNX

Year Treated	1949	1950	1951	1952	1953	1954	Total
No Patients	4	4	9	16	13	13	59
Alive	1	1	3	4	4	9	22*

* Three of these had postradiation surgery

Two-million-volt radiation therapy was given to four patients in 1949, four in 1950, nine in 1951, 16 in 1952, 13 in 1953, and 13 in 1954 Twenty-two patients were alive at the time of their last report, and 37 were dead Six patients were operated upon after receiving two-million-volt radiation therapy, the lesion was excised in four, and radical neck dissection was performed in two Two of the former are alive and without evidence of recurrence, and one of the latter is alive with a question of persistence of disease Of the remaining 19 patients who are living, 15 are free of disease, three exhibit persistence of the original lesion and in one, metastasis is still present. Only one of the four patients treated five years ago is alive and without evidence of recurrence The average survival time of the 37 patients who died was nine and a half months

Seventeen patients with malignant disease of the nose or paranasal sinuses were treated with two-million-volt radiation (see Table VI) Two patients were treated in 1950 two in 1951, four in 1952, seven in 1953, and two in 1954 Surgical or radiation therapy, or both had been employed without success in eight patients, or 47 per cent, before they were given supervoltage radiation The pathologic diagnosis was epidermoid carcinoma in five patients, carcinoma simplex in three, undifferentiated carcinoma in two, poorly differentiated carcinoma in one, adenocarcinoma in one, anaplastic carcinoma in one, rhabdomyosarcoma in two angiosarcoma in one, and reticulum cell sarcoma in one. The malignancy was localized to the mucous membrane of the nose in two patients, while the sinuses were involved in the remaining 15 patients Metastatic disease was present in four of these patients Only seven of the 17 patients are alive, and none was treated five years ago

TABLE VI

MALIGNANCY OF THE NOSE AND SINUSES

Year Treated	1949	1950	1951	1952	1953	1954	Total
No Patients	0	2	2	4	7	2	17
Alive	0	0	0	3	3	1	7*

* One of these had postradiation surgery

Carotid body tumors occasionally are malignant and cannot be excised, because the common carotid artery cannot be sacrificed Two patients with carotid body tumor have been treated with two-million-volt radiation (see Table VII) One of these patients previously had a carotid tumor removed which prevented any possibility of further excision One patient was treated in 1950, and the other in 1953 Both are living, the former without evidence of tumor, the latter with a tumor mass which presents no evidence of activity

TABLE VII

CAROTID BODY TUMOR

Year Treated	1949	1950	1951	1952	1953	1954	Total
No Patients	0	1	0	0	1	0	2
Alive	0	1	0	0	1	0	2

Neoplasms of the parotid gland are considered to be radioresistant Thirteen patients with malignant disease of the parotid gland and one patient with extensive, recurrent, mixed tumor of the parotid gland have been exposed to two-million-volt radiation therapy (see Table VIII) All but one patient had previously been subjected to surgical intervention without success on at least one occasion One patient had biopsy of the tumor mass only The pathologic diagnosis was adenocarcinoma in five patients, carcinoma simplex in four, epidermoid carcinoma in one, poorly differentiated carcinoma in one, fibrosarcoma in two, and a mixed tumor in one The last mentioned had failed to be eradicated after numerous operations, and at the time radiation therapy was employed the tumor extended so widely that it was anatomically impossible to effect complete surgical removal

TABLE VIII

MALIGNANCY OF THE PAROTID GLAND

Year Treated	1949	1950	1951	1952	1953	1954	Total
No Patients	0	3	3	4	2	2	14
Alive	0	3	3	4	2	2	14

Two-million-volt radiation was administered to three patients in 1950, three in 1951, four in 1952, two in 1953, and two in 1954 All are alive, and 10 present no evidence of persistent or recurrent disease The remaining four patients exhibit suggestive evidence of persistent disease, but whether or not it is viable cannot be determined In one patient with carcinoma simplex a Brown-Séquard syndrome developed following radiation, but on last report, 56 months after completion of radiation, there was no evidence of recurrence

UNIVERSITY OF ILLINOIS ANNUAL ASSEMBLY IN OTOLARYNGOLOGY

The Department of Otolaryngology, University of Illinois College of Medicine, announces its Annual Assembly of Otolaryngology from September 19 through October 1, 1955 This Assembly will consist of two parts

Part I — September 19 through September 24, 1955, will be devoted to surgical anatomy of the head and neck, fundamental principles of neck surgery and histopathology of the ear, nose and throat. This week will be under the personal direction of Maurice F Snitman, M D

Part II — September 26 through October 1, 1955, will be devoted entirely to lectures and panel discussion of advancements in otolaryngology The chairman of this section will be Emaneul M Skolnik, M D

Registration is optional for one or both weeks For further information, address Dr Francis L Lederer, 1853 West Polk St., Chicago 18, Ill

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POST GRADUATE COURSES AT TEMPLE UNIVERSITY

The following Post-Graduate Courses to be given in this Department during the current year

Post Graduate Course in Broncho-Esophagology, October 17 - 28, 1955

Post-Graduate Course in Laryngology and Laryngeal Surgery, September 19 - 30, 1955

These courses are all to be given in the Department of Laryngology and Broncho-esophagology, Temple University Hospital and School of Medicine, under the direction of Dr Chevalier L Jackson and Dr Charles M Norris The tuition fee for each course is $250 00 Further information and application blanks can be obtained from Dr Chevalier L Jackson, 3401 N Broad Street, Philadelphia 40, Pennsylvania

SOUTH CAROLINA SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

Plans have been completed for a joint meeting of the North Carolina Eye, Ear, Nose and Throat Society and the South Carolina Society of Ophthalmology and Otolaryngology at Columbia, S C, on September 12, 13, and 14, 1955 Headquarters will be the Columbia Hotel

The following ophthalmologists will be on the program Dr E W D Norton of New York, Dr Frank Carroll of New York, and Dr William B Clark of New Orleans

A most attractive program has been arranged For further information address Roderick Macdonald, M D, Secretary and Treasurer, 330 East Main Street, Rock Hill, S C

SOUTH AFRICAN LOGOPEDIC SOCIETY

The South African Logopedic Society (Society of Speech Therapists) publishes a Journal in May and October of each year Articles deal with the organic and psychological aspects of speech defects, and include subject matter of interest to the medical and allied professions

Relevant contributions in the field of otolaryngology are invited

Subscriptions are 10/– per annum including postage and should be addressed to The Editor, Journal of the S A Logopedic Society, Witwatersrand University, Milner Park, Johannesburg, So Africa

THE AMERICAN OTORHINOLOGIC SOCIETY FOR PLASTIC SURGERY, Inc

A short course on Plastic Surgery of the Head and Neck will be given by The American Otorhinologic Society for Plastic Surgery at the Morrison Hotel, Chicago, Illinois, extending from October 7 to October 9, 1955, inclusive For details write Dr Louis J Feit, 66 Park Avenue, New York, N Y

COLBY COLLEGE — AUDIOLOGY FOR INDUSTRY

Colby College, Waterville, Maine, presents the Third Annual Course in Industrial Deafness, August 7 - 13 inclusive Objective of the course will be to train personnel in initiating and in conducting conservation hearing programs in noisy industries Seven full time instructors have been selected from authorities in this field Class limited to 20 participants

Registrants will live on the College Campus and the Tuition fee of $200 00 includes board and room Applications should be made to Mr William A Macomber, Director, Division of Adult Education and Extension, Colby College, Waterville Maine. Frederick Thayer Hill, M D, Director, Joseph Sataloff, M D, Assistant Director

BRONCHOESOPHAGOLOGY COURSE

The next Bronchoesophagology Course to be given by the University of Illinois College of Medicine is scheduled for the period October 24 to November 5, 1955, under the direction of Dr Paul H Holinger

Interested registrants will please write directly to the Department of Otolaryngology, University of Illinois College of Medicine, 1853 West Polk Street, Chicago 12, Illinois

AMERICAN ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY HOME STUDY COURSES

The 1955 1956 Home Study Courses in the basic sciences related to ophthalmology and otolaryngology, offered as a part of the educational program of the American Academy of Ophthalmology and Otolaryngology, will begin on September 1, and continue for a period of ten months Detailed information and application forms can be secured from Dr William L Benedict, the executive secretary-treasurer of the Academy, 100 First Avenue Building, Rochester, Minnesota. Registrations should be completed before August 15

DIRECTORY OF OTOLARYNGOLOGIC SOCIETIES

(Secretaries of the various societies are requested to keep this information up to date)

AMERICAN OTOLOGICAL SOCIETY

President Dr Wm J McNally, 1509 Sherbrooke St., West Montreal 25, Canada
Vice-President Dr John R Lindsay 950 E 59th St Chicago 37, Ill
Secretary Treasurer Dr Lawrence R. Boies, 90 S Ninth St., Minneapolis 2 Minn
Editor Librarian Dr Henry L Williams, Mayo Clinic, Rochester, Minn
Meeting Seigniory Club, Montreal, Canada, May 11-12, 1956

AMERICAN LARYNGOLOGICAL ASSOCIATION

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First Vice-President Robert L Goodale, 330 Dartmouth St., Boston, Mass
Second Vice President Paul H Holinger, 700 North Michigan Ave, Chicago 11, Ill.
Secretary Harry P Schenck, 326 South 19th St. Philadelphia 3, Pa
Treasurer Fred W Nixon, 1027 Rose Building, Cleveland, Ohio
Librarian Historian and Editor Edwin N Broyles, 1100 North Charles St Baltimore, Md
Meeting Mount Royal Hotel, Montreal, Canada, May, 1956

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President Elect Dr Percy Ireland, Toronto Canada.
Secretary Dr C Stewart Nash, 277 Alexander St., Rochester, N Y
Meeting Mount Royal Hotel, Montreal, Canada, May, 1956

AMERICAN MEDICAL ASSOCIATION, SECTION ON LARYNGOLOGY, OTOLOGY AND RHINOLOGY

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President Dr Algernon B Reese, 73 East 71st St, New York 21, N Y
Executive Secretary Dr William L Benedict Mayo Clinic Rochester Minn
Meeting Palmer House, Chicago, Ill, October 9 15, 1955

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Secretary Dr F Johnson Putney, 1719 Rittenhouse Square, Philadelphia Pa
Meeting Sheraton Mount Royal Hotel Montreal Canada May 15 16, 1956 (afternoons only)

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Meeting Palmer House Chicago Ill, October 2 8, 1955

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Secretary Treasurer Dr Michael H. Barone 468 Delaware Ave Buffalo 2, N Y
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PAN AMERICAN ASSOCIATION OF OTO-RHINO LARYNGOLOGY AND BRONCHO-ESOPHAGOLOGY

President Dr J M. Tato Azcuenaga 235 Buenos Aires Argentina
Executive Secretary Dr Chevalier L. Jackson, 3401 N Broad St., Philadelphia 40 Pa., U S A.
Meeting Fifth Pan American Congress of Oto-Rhino-Laryngology and Broncho-Esophagology
Time and Place April 8 12 1956 San Juan Puerto Rico
President Dr J H. Font, Medical Arts Bldg. San Juan P R.

SIXTH INTERNATIONAL CONGRESS OF OTOLARYNGOLOGY

President Dr Arthur W Proetz, Beaumont Bldg St. Louis Mo
General Secretary Dr Paul Holinger 700 No Michigan Ave Chicago (11) Ill.
Meeting Statler Hotel Washington D C May 5 10 1957

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Meeting First Monday of each Month October through May

OTOSCLEROSIS STUDY GROUP

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Secretary Dr Lawrence R Boies, Med Arts Bldg, Minneapolis 2, Minn
Meeting Palmer House, Chicago, Ill, Oct. 9, 1955

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Secretary of Section on Otolaryngology Ross A. Goodcell, M.D
Place Los Angeles County Medical Association Building 1925 Wilshire Boulevard, Los Angeles California.
Time 6 00 P.M first Monday of each month from September to June inclusive—Otolaryngology Section. 6 00 P.M., first Thursday of each month from September to June inclusive—Ophthalmology Section

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President Lester T Jones, M D, 624 Medical Arts Bldg, Portland (5), Oregon
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Meeting April 15 19, 1956

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President Dr G Edward Tremble, 1390 Sherbrooke St., West, Montreal, P Q
Secretary Dr G Arnold Henry, 170 St George St, Toronto, Ontario
Meeting

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President Dr Antonio da Costa Quinta, Lisbon Portugal
Secretary Dr Chevalier L. Jackson, 3401 N Broad St. Philadelphia 40 Pa, U S A.
Meeting Fourth International Congress of Bronchoesophagology
Time and Place Buenos Aires, October 28 29, 1955

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Secretary
Meeting Lima, Peru, 1957

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REFLUX ESOPHAGITIS *

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Jacksonville, Fla.

Until recent times, little attention has been given to an inflammatory condition of the lower portion of the esophagus, now designated reflux or peptic esophagitis The otolaryngologist has been well versed in the diagnosis and treatment of chemical burns and resultant stenotic lesions of the esophagus but has manifested less familiarity with other etiologic factors of esophagitis

Winkelstein,[14] in 1935, described a "new clinical entity," which he named peptic esophagitis Noting a relationship between acute esophagitis and peptic ulcer of the stomach and duodenum, he ascribed the inflammation of the esophagus in such cases to the action of pepsin and hydrochloric acid on a susceptible mucosa. There is a high degree of susceptibility of the nonresistant squamous mucosa of the esophagus to prolonged contact with gastric and intestinal secretions Other causes of peptic esophagitis are regurgitation accompanying vomiting, and reflux of gastric contents because of some impairment of the sphincter-like action of the cardioesophageal junction associated with sliding hiatal hernia or the surgical excision of the cardiac sphincter The term reflux esophagitis introduced by Allison,[1] accurately describes this entity, also it seems preferable to peptic esophagitis, because peptic carries the connotation of association with ulcer of the stomach and duodenum

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Esophagitis is the lesion most frequently encountered in the esophagus,[33] nevertheless, it has not received the attention it deserves in medical literature[32] From a clinical standpoint, the esophagus has remained shrouded in mystery In the opinion of Vinson,[35] the gastroenterologist has been too prone to consider the esophagus outside his diagnostic domain, and the otolaryngologist too frequently has limited his study of this organ to inspection through an esophagoscope In addition, there has been a tendency to permit the roentgenologist to rule out organic disease of the esophagus, and diagnostic esophagoscopy has been a neglected procedure[33] Recently, however, the literature has reflected increasing interest in this organ

The purpose of this presentation is to discuss the subject of reflux esophagitis with regard to anatomy and physiology, pathology, symptoms, diagnosis, etiology as illustrated by specific cases, and treatment Study of this disease and experience in dealing with its manifestations, as demonstrated by the cases reported, indicate the importance of creating an awareness of this entity, for it appears to be more prevalent than is generally realized

ANATOMY

Of Greek derivation, the term esophagus means to carry food, a definition which explains the main function of the musculomembranous tube extending from the lower border of the pharynx to the stomach This tube originates at the level of the lower border of the cricoid cartilage opposite the sixth cervical vertebra and enters the stomach and the abdomen at the level of the tenth thoracic vertebra The average length of the adult esophagus is 10 inches The respective layers of the esophagus from within out are the mucosa, lamina propria mucosae, muscularis mucosae, submucosa, muscularis propria, and adventitia The mucous membrane lining is made up of stratified squamous epithelium Food passes through the esophagus with great rapidity There is no need here for an absorptive or digestive role[40] The lining epithelium's main function is that of a protective coating Since no absorption occurs, there is little need for lymphatic tissue to filter any tissue fluid Small amounts of lymphatic tissue are present, however, in areas where ducts or glands pass through the lamina propria.[16] The transition from the stratified squamous epithelium to the gastric epithelium is histologically abrupt.[33]

There are two types of esophageal glands the deep or true esophageal mucous glands have a sparse and uneven distribution over the length of the esophagus There are seldom more than 200 mucous glands in the human esophagus, and about two-thirds of these occur in the upper half[33] These glands lie in the submucosa, and each has a single secretory duct lined with stratified squamous epithelium The superficial or esophageal cardiac glands lie in the mucosa They are morphologically similar to gastric cardiac glands Most of these are concentrated between the level of the cricoid cartilage and the fifth tracheal ring and the distal few millimeters of the esophagus Palmer[33] believed that the histologic similarity of the normal esophageal cardiac glands to the gastric cardiac glands accounts for some confusion in the literature regarding the diagnosis of heterotopic gastric mucosa in the esophagus In his opinion, the diagnosis of the abnormal state must depend on the identification of both gastric parietal and chief cells in the tissue questioned

The muscularis propria consists of an outer longitudinal layer and an inner circular layer It is composed of both smooth and striated muscle. The latter extends down to the middle of the esophagus the remaining portion is made up of smooth muscle fibers

The nerve supply is derived from the sympathetic and parasympathetic nervous system. The sympathetic fibers are supplied through the cervical and thoracic parts of the sympathetic chain, and the parasympathetic fibers are supplied through the vagus and recurrent laryngeal nerves The intrinsic nerve plexus of Meissner and that of Auerbach are present in the esophagus, the former in the submucosal layer and the latter between the inner and outer muscle layers

The Terminal Portion of the Esophagus—A review of the literature indicates wide diversity of opinion regarding the anatomy and physiology of the terminal portion of the esophagus There is also disagreement as to the presence of a true sphincter at the gastroesophageal junction

In the cadaver the gastroesophageal junction lies opposite the tenth or eleventh cervical vertebra During life its position is variable because of the excursions of normal diaphragmatic movements

The diaphragm is a muscular sheet composed of fibers radiating from the lower border of the thorax and from the upper lumbar vertebrae toward a central tendinous area These muscle fibers are grouped into three portions according to their origin the sternal, costal, and lumbar The two crura which form the hiatus for the esophagus arise from the lumbar portion Behind the posterior margin of the central tendon, the crural fibers diverge to surround in a sphincter-like manner the hiatus for the esophagus Mosher[25] demonstrated that the anterior or right crus is thin and may be membranous The posterior crus is sturdy, it makes a prominent crease on the posterior surface of the esophagus and notches its left border In his opinion the form of the crural sling varies and with it the form of the terminal portion of the esophagus He divided this portion of the esophagus into a vertical and horizontal arm This division is due to a twist of the esophagus on itself from right to left at the crura of the diaphragm This author observed a close relationship between the lower segment of the esophagus and the liver and believed the latter responsible for the shape of the lower end of the esophagus

Palmer[33] noted that the esophagogastric junction lies immediately anterior to the medial border of the spleen Mosher[25] stated that the horizontal arm of the terminal portion of the esophagus is imprisoned between the posterior crus and the posterior surface of the liver in front The anterior crus comes in between the liver and the horizontal arm in front He concluded that to and fro movements of the liver will open and close the horizontal portion of the lower part of the esophagus and that its patency is controlled by the position of the liver It was his belief that the terminal portion of the esophagus is closed during the resting state because of the pressure in the crural canal, the pressure of the deep vertical folds, and the natural twist to the left, also that a weak sphincter can be demonstrated occasionally at the lower end of the esophagus He noted a thickening of both muscular layers of the esophageal wall at the line where the esophageal mucosa changes into gastric mucosa, which he considered to be a cardiac sphincter It was his conclusion that a cardiac sphincter is not always present, and in five out of seven of his dissections he observed that the esophageal muscles came to a definite ending at the level of the crura and did not reach the cardia In his opinion the musculature of the lower end of the esophagus or upper end of the stomach has a weak sphincteric action regardless of the presence or absence of an anatomic sphincter

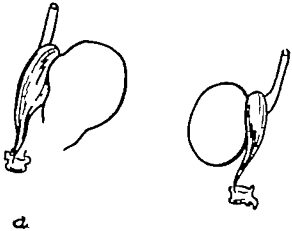

Fig 1a. The right crus of the diaphragm forming a sling for the esophagogastric junction Anterior view b The sling of the right crus as seen from the side Redrawn from Allison's

According to Allison,[1] the cardia allows food to pass from the esophagus to the stomach and prevents the reflux of digestive juices from the stomach into the esophagus There is no thickening of circular muscle fibers of the esophagus to form a sphincter The esophagus bends forward and to the left, and this bend is lassoed and maintained by the right crus of the diaphragm which hitches it down to the lumbar spine (see Fig 1) The esophageal hiatus is a split in the muscle fibers of the right crus, which is tightly reinforced by fibers from the left The esophagus is supported in front by a sling of muscle fibers continuous on each side with the perpendicular fibers of the crus and decussating with one another to form a stoutly reinforced raphe There is less support behind because the crus splits here to form the hiatus Pressure from below at this point splits the fibers to increase the size of the opening When the right crus of the diaphragm contracts, it compresses the walls of the esophagus from side to side and pulls down and increases the angulation of the esophagus, both from before backward and from side to side It is during inspiration when the suction pressure in the chest would tend to draw the gastric contents into the esophagus that the crus of the diaphragm contracts and prevents this reflux In addition to making these observations, this author concluded that no internal sphincter can be demonstrated He believed that there is an intrinsic mechanism which contributes to continence Part of this mechanism is the oblique line of entry of the esophagus into the stomach and contraction of the circular muscle fibers of the esophagus and the oblique fibers of the stomach Carver and Sealy[10] believed that the contraction of these muscles produces a purse-string action They suggested that air in the cardia produces a pressure effect which tends to collapse the esophagus and increase the esophagocardiac angle

Lerche[27] studied in cadavers the closing mechanism between the stomach and esophagus which he believed had been active in a phase of regurgitation of stomach contents at the time of death. He concluded that there is a double closing mechanism between the stomach and esophagus The structures involved in this mechanism were considered by him as a unit which he labeled "the gastroesophageal segment of expulsion" This unit consists of (*1*) the phrenoesophageal elastic membrane, (*2*) the ampulla, (*3*) the inferior esophageal sphincter, (*4*) the gastroesophageal vestibule, and (*5*) the constrictor cardiae

The phrenoesophageal elastic membrane originates from the fascia of the diaphragm, enters both muscle layers at the lower end of the esophagus and terminates in the inferior esophageal sphincter above the diaphragm There is a descending portion which covers the subhiatal fat ring This membrane maintains proper relationship between the esophagus, the diaphragm, and the stomach It restrains excessive shortening of the esophagus during the contraction of the longitudinal muscle layer and serves as a barrier against intra-abdominal pressure. Lerche[27] believed that the esophagus terminates above the hiatus of the diaphragm in the ampulla, the lower end of which is always closed by the inferior esophageal sphincter, which is always in tonic contraction except during the passage of contents The ampulla is a dilatation of the lower portion of the esophagus which is only discernible after food has been introduced He described it as 1 5 to 2 cm in length and varying in shape with the state of contraction of its musculature

The *inferior esophageal sphincter, according to this author,* is a circumscribed thickening of the muscular wall above the hiatus of the diaphragm This sphincter is always closed in tonic contraction, and in his opinion it is the only closure between the negative pressure of the esophagus and the positive pressure in the stomach In a large number of the specimens this was 1 to 2 cm above the diaphragmatic hiatus The thickness of the muscle varied greatly, in many specimens from 3 to 5 mm In a few cases there was no difference in thickness of the muscle wall here and elsewhere in the esophagus He concluded that the thickness depends upon the state of contraction of the muscle

The gastroesophageal vestibule is a dilatation between the inferior esophageal sphincter above and the constrictor cardiae below The constrictor cardiae consists of a right and left sling of muscle fibers which form a circular muscle ring during contraction

Lerche[27] described the passage of food from the terminal end of the esophagus to the stomach as follows after the bolus enters the ampulla, the esophageal sphincter opens mechanically or reflexly to the peristaltic pressure above the ampulla The inferior esophageal sphincter then contracts and forces the bolus into the gastroesophageal vestibule When the latter is filled the inferior esophageal sphincter closes, and the constrictor cardiae opens as the vestibule shortens by contraction of the deep longitudinal muscle layer which pulls it to the sphincter The contents are then introduced into the stomach through the orifice of the constrictor cardiae He believed that the constrictor cardiae functions as an adjustable mouthpiece which controls the pressure in the vestibule and the passage of swallowed material of varying consistency After the expulsion of the contents, the constrictor cardiae projects into the stomach, and the gastroesophageal vestibule extends with it The constrictor cardiae relaxes, and the mucosa of the vestibule everts into the stomach (see Fig 2)

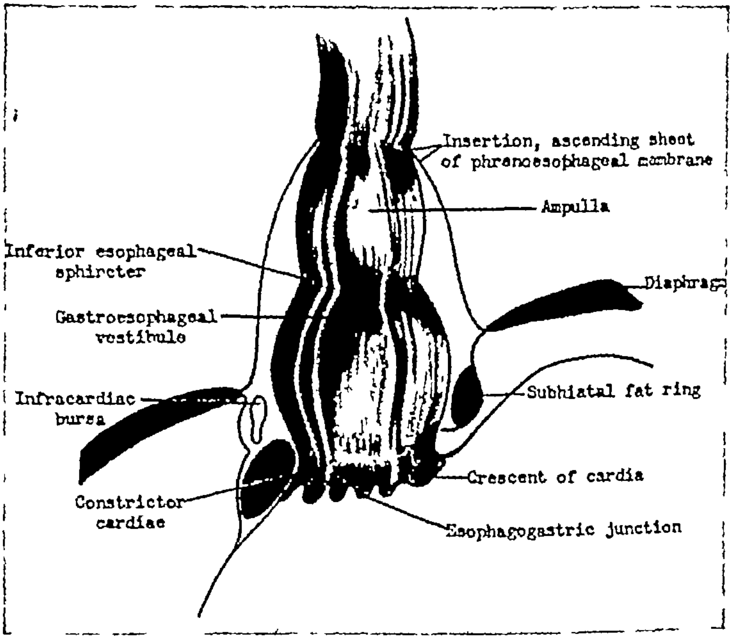

Fig 2 The gastroesophageal segment of expulsion as described by Lerche Redrawn from Palmer[33]

Templeton[44] stated that roentgenologic observations on man indicate the presence of both a sphincter inherent in the walls of the lower portion of the esophagus and a pinchcock action which plays a part in closing the terminal portion of the esophagus

PATHOLOGY

Early acute ulcerative esophagitis is manifest in the esophagus by patchy superficial erosion, surface exudate, and hyperemia of the involved portions with or without petechiae

The distal portion is affected in almost all cases, and in approximately two thirds this segment alone is involved.[23] Small oval erosions are distributed in longitudinal streaks. Bartels,[3] in 1935, found evidence of ulcerative esophagitis in 82 of 6,000 fresh and preserved esophageal specimens, an incidence of 0.013 per cent. In all of these specimens the esophagus was dilated, especially the lower third.

The incidence of esophagitis in the esophageal specimens of 3,032 necropsies, examined by Butt and Vinson[9] in 1936 was 7.02 per cent. In 76.5 per cent of the 213 cases of esophagitis in this series the lesions were of the acute ulcerative type. There was a denuding of the lining epithelium. The inflammatory reaction, varying from mild to severe, involved the submucosa and both layers of muscle. Polymorphonuclear leukocytes predominated. Hemorrhage was evident in the various layers. The mucous glands were inflamed, and the ducts blocked and dilated. Vessels dilated and engorged with erythrocytes were present in the submucosa. A ruptured vessel occasionally was seen in the lumen of the esophagus, and thrombosed vessels and lymphatic vessels filled with leukocytes were also observed occasionally. A subacute process manifest by a denuding of the epithelial layer and an infiltration with leukocytes was observed in 31, or 14.5 per cent, of the cases. Beginning fibroblastic proliferation was present. In 14, or 6.5 per cent, of the cases a chronic process was indicated by replacement of most of the muscularis mucosae and submucosa with fibrous tissue. The thickness of the subepithelial connective tissue was appreciably increased. These authors believed the areas of fibrosis represented the result of repeated attacks of esophagitis with healing. Accompanying the increased fibrosis was a diminished blood supply to the mucous membrane, which decreased the normal resistance of this tissue. This change, in their opinion, probably facilitated recurrent attacks of esophagitis.

Inflammatory change may penetrate the walls of the esophagus deeply enough to produce a stricture of this organ with resultant dysphagia within a month or two of the time of the onset of the inflammatory process.[16] The progressive course of an untreated acute ulcerative esophagitis is chronic ulceration, fibrosis, and benign stricture formation[1,6,10,11,20,26,37-48] As in the stomach and duodenum, this course may be complicated by bleeding or perforation

SYMPTOMS

The symptoms of reflux esophagitis vary from bizarre thoracic pain to pronounced dysphagia and hemorrhage In a patient of the psychoneurotic type, probably too often the early symptoms are considered functional in nature and are disregarded by the physician Butt and Vinson[9] noted definite clinical symptoms in only 10 3 per cent of 213 patients Substernal burning and pain, hematemesis, and dysphagia were the most common symptoms in their series, and obstruction was a late symptom Symptoms listed by Carver and Sealy[10] were substernal pain, nausea, regurgitation, vomiting, dysphagia, aphagia, hematemesis, and melena Characteristically, they observed, these symptoms occur either alone or in various combinations according to the stage of the disease The earliest symptom is usually substernal pain, often described as "heartburn," which at first is transient and promptly relieved by ingestion of bland food or antacids The pain increases in severity as the disease progresses and may persist for several hours after meals without relief after the swallowing of antacids or bland food It may radiate to the head, neck, or back, or down the arm as in acute coronary insufficiency These authors explained the radiation of the pain on the basis of the sympathetic and parasympathetic innervation of the esophagus, which is cervical, thoracic, and vagal in origin and similar to the innervation of the heart As the disease progresses, dysphagia results from muscle spasm and edema Later ulceration occurs, resulting in fibrosis, cicatricial stenosis, and shortening of the esophagus

Loss of weight and anemia are frequently associated findings Patients dread swallowing so much that they refuse to eat, or soon find they can take only a liquid diet, for to ingest solid food is to risk complete obstruction Regurgitation of saliva, especially before arising in the morning, is a distressing symptom Also, in almost all cases occult blood is demonstrable in the stool, with severe hematemesis and melena occurring in about 10 per cent of the cases[9]

DIAGNOSIS

The diagnosis of reflux esophagitis depends first on the recognition of the symptoms Vague symptoms of fulness in the chest and choking sensations associated with retrosternal burning deserve prompt evaluation and should not be discarded as functional complaints. A carefully taken history should be followed by Roentgen examination of the gastrointestinal tract. The differential diagnosis should exclude angina pectoris, cholecystitis, peptic ulcer of the stomach or duodenum, carcinoma of the esophagus, true cardiospasm, and peptic ulceration of the thoracic stomach[4] The roentgenologist should be informed of the history and of the possibilities of reflux esophagitis when the patient is referred to him He then may look carefuly for evidence of sliding hernia, gastric reflux, or other abnormalities of the lower portion of the esophagus

The sphincteric action of the cardia prevents regurgitation of barium into the esophagus when the normal subject lies in the Trendelenburg position Regurgitation of barium from the cardia into the esophagus occurs in subjects suffering from cardioesophageal reflux The regurgitation may fill only the lower end of the esophagus or may fill the esophagus as far as the mouth[11] Samuel[18] advised a careful search for signs of reflux esophagitis in patients showing cardioesophageal reflux, for it does not occur in all such patients Other Roentgen findings in reflux esophagitis are spasm of the esophagus, irregularity of the mucosal contours, and stenosis An ulcer crater niche may be demonstrated in peptic ulcer of the esophagus secondary to reflux esophagitis Care should be exercised in differentiating esophageal carcinoma from reflux esophagitis

Hiatal hernia with or without spasm or stricture above is the most common Roentgen finding in this disease[4] The Roentgen diagnosis of hiatal hernia and shortened esophagus is important. Dawson[11] described the difficulty in differentiating an epiphrenic ampulla from a hiatal hernia A positive Roentgen diagnosis of hiatal hernia should not be made unless it is demonstrated that reflux and filling of the hiatal hernia are spontaneous from a barium filled stomach His method is to fill the stomach with barium with the patient in the erect position and then to tilt the patient into the Trendelenburg position to produce reflux of barium into the hiatal hernia Should this procedure fail to demonstrate a hiatal hernia, the patient stands in the erect lateral position and bends to touch his toes If the hiatus is incompetent, a hiatal hernia of the stomach will bulge above the diaphragm

Esophagoscopy should be performed in patients with Roentgen evidence of esophagitis The persistence of esophageal symptoms in the absence of positive Roentgen findings still requires esophagoscopic examination Carcinoma must be differentiated from stricture formation in the late stages of reflux esophagitis Repeated esophagoscopies and biopsies are necessary in suspicious cases The specimen for biopsy should be taken from the deep layers of the esophagus The esophagoscopic findings vary with the stage of the disease In acute reflux esophagitis, the mucosa is diffusely edematous and inflamed Small ulcers with whitish exudate may be present, the exudate is readily stripped off, leaving a bleeding surface There may be a discrete ulcer with an inflammatory reaction Spasm of the esophagus may or may not be present in the early stages In later stages stricture formation occurs with pronounced narrowing of the lumen The mucosa is usually friable and bleeds easily with manipulation The presence of a shortened esophagus with a hiatal hernia may be established This condition is usually accompanied by an incompetent cardia, which facilitates the entrance of the esophagoscope into the stomach The usual narrowing and bending of the lower portion of the esophagus are absent in cases of this type

ETIOLOGY

Regurgitation of gastric contents in infants is a normal occurrence The muscles of the diaphragm strengthen with age and contribute to the normal function of the closing mechanism of the cardioesophageal function In a study of 310 autopsies in infants, Gruenwald and Marsh[21] noted evidence of acute esophagitis usually with ulceration in one out of every six infants The most common localization of esophageal ulcers was just above the cardia Inflammation ended abruptly where gastric mucosa began These authors believed that obstetric complications and severe asphyxia predispose an infant to esophagitis Five of six infants with kernicterus had esophagitis Perforation of an esophageal ulcer into the pleural cavity occurred in two cases They suggested that in many of the cases the lesions were "shock lesions" Anoxia and severe dehydration with resultant hemoconcentration were the suggested causes of shock. Vomiting occurred in 34 of the 52 cases in the series, and the vomitus contained blood in 17 The diagnosis of esophagitis is strongly suggested when an infant vomits blood

Beaconsfield[1] noted that spasm and fibrosis of the circular muscle fibers produce stenosis, while spasm or fibrosis of the longitudinal muscle fibers shortens the esophagus The shortening of the esophagus impairs the function of the cardiac sphincter He described a vicious cycle of inflammation, fibrosis, constriction, and contraction producing stricture and shortening of the esophagus drawing up the stomach into the thoracic cavity and increasing the size of the hiatal hernia which in turn favors the regurgitation of the gastric contents into the esophagus.

Most authors mention a close relationship between esophagitis and other diseases of the gastrointestinal tract especially those in which there is frequent vomiting or regurgitation of gastric secretions

Bartels[3] reported gastric contents in all of his cases of ulcerative esophagitis, and the flow between the stomach and the esophagus was uninterrupted He observed no ulceration in cases in which the esophagus was firm with normal folding rugae present.

Mechanical factors of stretching and the act of regurgitation may cause small breaks in the esophageal mucosa which, when bathed by gastric secretion, tend to produce congestion and erosion of the membrane[29]

Selye[41] was able to produce hemorrhagic esophagitis by ligating the pylorus in animals thus showing that prolonged contact between esophageal mucosa and gastric juice resulted in inflammation

Also by animal experimentation, Ferguson and his associates[16] demonstrated that contact of gastric juice with esophageal mucosa had a devastating effect It was much less damaging on intestinal mucosa Perfusion of a cat's esophagus with canine gastric juice resulted in a perforation of the esophagus in 19 minutes in one animal The lower third of the esophagus was always most severely damaged Hydrochloric acid alone in a similar concentration to that in gastric juice had a mild effect on the esophagus. When bile and pancreatic secretion were added to the gastric juice being applied, little damage occurred to the esophagus These investigators concluded that peptic activity is the important factor and that prevention and treatment of ulcerative esophagitis should be directed toward preventing reflux of gastric juice into the esophagus

The roentgenologist frequently sees Roentgen evidence of a reflux of barium from the stomach to the esophagus in the normal person In summarizing a review of the literature on regurgitation, Butt and Vinson[8] concluded that the strongest evidence favors the theory that regurgitation of gastric content into the esophagus occurs as a normal process in a high percentage of cases It was their opinion that the esophageal mucosa is a well protected membrane Mucus secreted by the esophageal, nasal and pharyngeal glands forms a continuous blanket protecting the membrane lining of the esophagus They concluded that it is only when there is an inadequate amount of mucus present or when the membrane is injured in some way that the regurgitated gastric juice plays an important role in the production of ulcerative esophagitis

Indwelling feeding and suction tubes may be an etiologic factor in reflux esophagitis Trauma to the esophageal mucosa by these tubes may make it more susceptible to the reflux of gastric juice The indwelling tube may straighten partially the kinking of the lower portion of the esophagus and encourage the gastric reflux Benedict and Gillespie[5] suggested that patients requiring prolonged intubation are those more likely to vomit and have gastric reflux with or without the indwelling tube The danger of peptic digestion with indwelling stomach tubes is particularly high in patients suffering from prolonged debility or unconsciousness[35] In 20 per cent of the cases reported by Butt and Vinson[9] there was associated peptic ulcer of the stomach or duodenum, and in half of these cases the patient had vomited or had had gastric contents removed by tube or both

Postoperative Reflux Esophagitis—Two cases are described which illustrate the occurrence of reflux esophagitis following cholecystectomy In Case 1 an indwelling tube and vomiting postoperatively were factors, and in Case 2 reflux of gastric content was among the suggested etiologic factors

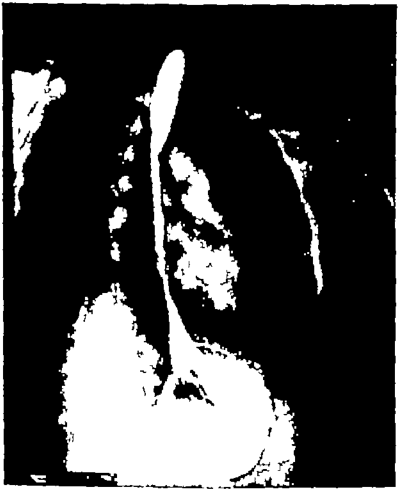

Fig 3 Case 1.—Roentgenogram showing narrowing and irregularity of the lower two thirds of the esophagus on Nov 1952

Case 1 J H W., a white woman aged 64 complaining of dysphagia was referred by an internist on Dec 11 1952 For several months prior to cholecystectomy on the preceding August 16 recurrent episodes of upper abdominal discomfort associated with nausea and occasional vomiting had increased in severity There was Roentgen evidence preoperatively of several stones in the gallbladder but the esophagus and stomach were normal in appearance. For four days after uneventful cholecystectomy a Levin tube was left in place On the fourth postoperative day severe and persistent vomiting occurred and continued intermittently for three weeks. Following discharge from the hospital on the forty-sixth post operative day, the patient was seen at home by her physician on several occasions because of recurrent symptoms of esophageal spasm manifested by a stoppage of food at the manubrial level She experienced frequent regurgitation of food and liquids and complained of substernal pain radiating to the neck and back A barium swallow on September 18 demonstrated a normal appearing esophagus but on November 22 a second examination by barium swallow gave evidence of narrowing and irregularity of the lower two thirds of the esophagus (see Fig 3) Gastric analysis before and after administration of histamine demonstrated gastric acidity to be within normal limits

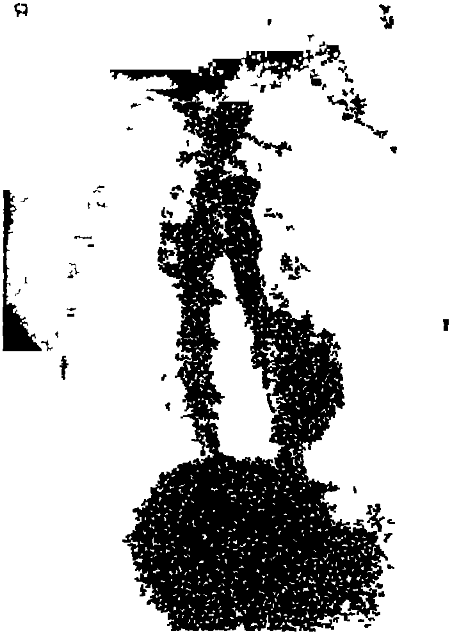

Fig 4 Case 1—Roentgenogram showing advanced esophageal narrowing on March 26 1954 16 months later

On esophagoscopy one week after the patient first consulted me the mucosa of the esophagus had an edematous appearance throughout with retained greenish secretions present in the upper portion At a point 25 cm from the upper alveolus the esophagus narrowed markedly, and the very red, acutely inflamed tissue bled easily upon manipulation The diagnosis was acute esophagitis The report on the histopathologic examination of the specimen taken for biopsy was a granulomatous inflammatory process with necrotic tissue

For six weeks thereafter it was possible to pass a No 16 French Hurst dilator although dilatation was especially difficult because of pain nausea and apprehension On March 5, 1953, it became necessary to resort to gastrostomy, and retrograde dilatations were carried out until June 2, when the gastrostomy was closed At the time of closure a No 38 French Tucker retrograde dilator was in use and dilatations from above were easily carried out with a No 24 French Hurst dilator Dilatations with the Hurst dilator were continued until September Gradual narrowing of the esophagus then recurred When it was possible to use only a No 16 French Hurst dilator dilatation over a string was begun and is still being continued with the Hurst dilator being used intermittently There have been 84 dilatations to date and a No 27 French dilator is now employed

On March 23 1954 esophagoscopy was repeated The upper portion of the esophagus appeared normal Thirty centimeters from the upper alveolus the esophagus narrowed markedly the mucous membrane was greatly inflamed and upon manipulation bled easily Roentgen examination three days later demonstrated a slightly dilated upper portion of the esophagus with tapering at the level of the seventh and eighth dorsal vertebrae and stricture formation at the ninth dorsal vertebra (see Fig. 4) This area appeared to be seven inches in length There was a lack of peristalsis throughout the lower half of the esophagus

Comment.—This case illustrates an acute reflux esophagitis progressing through the chronic phase to stricture formation apparently due to severe vomiting following surgery The persistence of the activity for two years is noteworthy Dilatation over the string until recently has been very painful with pain radiating to the back and neck, and has frequently been followed by slight bleeding The persistent activity probably has been due to continued reflux of gastric juice into the acutely inflamed esophagus The patient has been most resistant to any suggestion of possible surgery to alleviate this problem At present the dilatations are at monthly intervals with a No 27 French dilator, and she is having less difficulty with swallowing than at any time in the past. I believe the condition will soon be stabilized In my opinion too frequent dilatations are contraindicated in this type of case The local trauma and spasm incident to dilating a tight stricture lead to increased stricture formation caused by persistent inflammation

Case 2 F McM., a white man aged 58 referred by an internist on April 27 1951 complained of dysphagia following cholecystectomy performed seven weeks previously Food seemed to lodge in the cervical region of the esophagus Pain radiated to the back and to the right side of the neck when he attempted to swallow solid food There was a history of dysphagia, indigestion and flatulence since boyhood with a tendency for many years to "swell up like a poisoned pup Since 1947 there had been repeated episodes of pain in the right upper quadrant of the abdomen radiating to the back on the right side. A Roentgen study of the gastrointestinal tract in 1948 yielded no evidence of abnormality except a slight spasm of the duodenum just distal to the cap and several small stones in the gallbladder

Following an acute episode in March 1951 cholecystectomy was performed. The gallbladder showed chronic cholecystitis with cholelithiasis two small calculi were removed. Other than slight vomiting on four occasions, the postoperative course was normal No feeding tube was passed Three weeks postoperatively, the patient could swallow nothing but liquids and complained of inability to swallow properly since the operation A fusiform narrowing of the lower third of the esophagus for some five inches with the lumen reduced to 4 or 5 mm in width was demonstrated by barium swallow Conservative treatment consisted of antacids, liquid and soft diet, and olive oil taken before meals. On gastric analysis before and after administration of histamine, gastric acidity was within normal limits

Esophagoscopy on April 28 the day after the patient first consulted me, disclosed a whitish membrane approximately 30 cm. from the incisor teeth It extended along the right lateral wall and could be stripped off easily The surface was acutely inflamed and bled easily Distal to this area the esophagus was markedly narrowed and inflamed

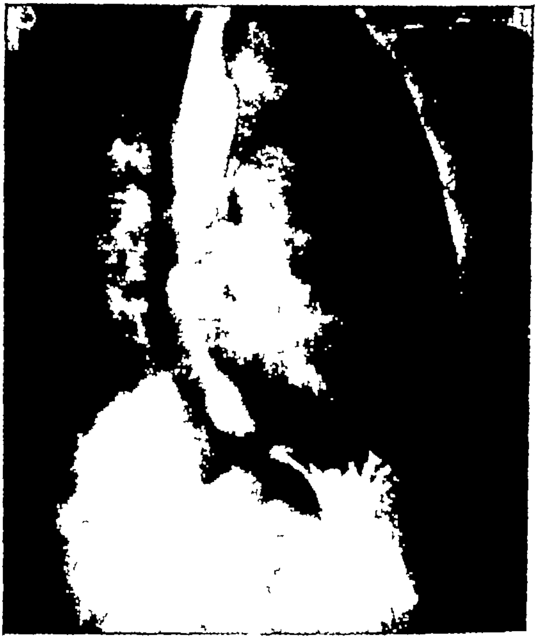

Fig 5 Case 2—Roentgenogram showing constant narrowing of the lower portion of the esophagus with dilatation above on March 26 1952

but there was no evidence of neoplasm The diagnosis was acute esophagitis Microscopic examination of the specimen removed for biopsy showed the tissue to be mostly necrotic with no cellular organization remaining All of the fields were filled with polymorphonuclear leukocytes, degenerated cellular debris and hemorrhage

The patient improved temporarily on an ulcer diet and antacid therapy but dysphagia soon became increasingly severe, with substernal burning persisting On May 5, esophagoscopy was repeated the inflammatory action was as previously, and there was increased narrowing of the lumen of the esophagus

At Duke Hospital Durham N C., where the internist then referred the patient the findings on esophagoscopy were similar and the diagnosis was nonspecific severe postoperative esophagitis Following gastrostomy performed there on May 19 he returned to my care for retrograde dilatations which were begun on July 10 with a No 34 French Tucker dilator and continued weekly In August a No 40 French retrograde dilator was passed with ease Dilatation with a Hurst dilator was begun in the third week and continued until a No 30 French dilator could be used with ease In September retrograde dilatations were discontinued and he swallowed a No 30 French Hurst dilator daily himself In October dilatation with a No 40 French Hurst dilator was carried out with ease, and he used this dilator himself without difficulty

At esophagoscopy on October 27 the distal portion of the esophagus still appeared narrow and inflamed with the underlying surface bleeding easily when the whitish exudate was stripped off There was much less dysphagia however with the patient himself using the No 40 French dilator every 48 to 72 hours without difficulty The gastrostomy was closed on December 17 Roentgen examination on March 26 1952 showed the constant narrowing of the lower portion of the esophagus with dilatation above (see Fig 5)

More than three years have elapsed since the patient first came under my observation and he now experiences no dysphagia. He carries out dilatation himself with a No 40 French dilator at monthly intervals or whenever he notices any indication of recurrent dysphagia.

Comment—The rapid onset of acute reflux esophagitis and stricture formation in this postoperative case in the absence of an indwelling tube or excessive vomiting is of interest. The possibility of esophagitis secondary to the spread of infection by the lymphatic route is suggested Relaxation of the cardioesophageal orifice at the time of cholecystectomy with bathing of the lower portion of the esophagus with gastric juice is another possibility In 23 4 per cent of the cases of acute ulcerative esophagitis reported by Butt and Vinson[9] chronic cholecystic disease was present and in 74 6 per cent the esophagitis occurred following operation Fifty-two of Bartels' 82 cases were observed following operation[4]

Reflux Esophagitis Associated with Duodenal Ulcer—Winkelstein, Wolf, Som, and Marshak[55] reported a series of 20 cases of reflux esophagitis The patients presented a long history of duodenal or gastric ulcer with a more recent and brief history of esophageal symptoms consisting of dysphagia, heartburn regurgitation substernal pain, and loss of weight. Fifteen per cent of them had a duodenal ulcer simultaneously There were 19 men and one woman in the series Fourteen were over 60 years of age These authors suggested that the gastric reflux into the esophagus might result from the hyper secretion associated with the duodenal ulcer or from an unexplained decrease in the tone of the cardiac sphincter Noting the high incidence of their cases in elderly persons, they proposed that a disturbance in the circulatory state of the mucosa or a loss of the mucous barrier might be an etiologic factor Complications noted by them were esophageal stenosis, hemorrhage and perforation Stenosis was the most common complication, occurring in nine cases They suggested that inflammatory swelling, spasm, and fibrous stricture play a part in the formation of the stenosis and that fibrous stenosing esophagitis occurs in the late stages of the severe cases In a series of 60 cases of benign stricture of the esophagus associated with reflux esophagitis, Benedict and Sweet[6] noted 20 cases in which duodenal ulcer was present

Wangensteen and Leven,[52] in 1939, performed a gastric resection for massive hemorrhage from a duodenal ulcer on a patient who had a history of esophagitis She had had frequent esophageal dilatations over a period of four years previously Following this operation, however, esophageal dilatations were no longer required Five other patients presenting clinical evidence of esophagitis, esophageal stricture, or both, obtained relief of esophageal obstruction following gastric resection Believing that esophagitis is probably a manifestation of ulcer disease, these authors suggested that the esophagus doubtless would replace the duodenum as the most common site for ulcers if it received all of the gastric juice as does the duodenum

Benedict and Gillespie[5] believed that the ulcer diathesis predisposes to the development of esophageal stenosis by virtue of the increased secretion of gastric juice and greater liability of gastric reflux even in the absence of pyloric stenosis They suggested that the ulcer patient might have changes in the mucosa of the lower portion of the esophagus which make it less resistant to acid peptic action In 19 of 50 patients with reflux esophagitis with complications subjected to surgery, Sweet, Robbins, Gephart and Wilkins[43] found evidence of ulceration in the duodenum

Case 3 F D C a white man aged 59 was referred by an internist on Aug 29 1950 He complained of dysphagia substernal distress and a sensation of food stoppage under the lower third of the sternum, symptoms noticed for several weeks Several months previously he related while eating chicken he had experienced a feeling of obstruction in the upper third of the esophagus followed by vomiting with no further difficulty in swallowing There had been two similar episodes in the past several weeks. Roentgen examination on August 21 had demonstrated an area of constant narrowing in the mid portion of the esophagus for a distance of about 4 cm characterized by smooth margins except for a 1 x 2 mm. projection of barium on the posterior aspect of the esophagus (*see Fig. 6*) *The maximum dilatation in this area was approximately 8* mm. The duodenal cap showed persistent deformity Interpretation at that time was esophagitis possibly accompanied by ulceration and an active chronic duodenal ulcer

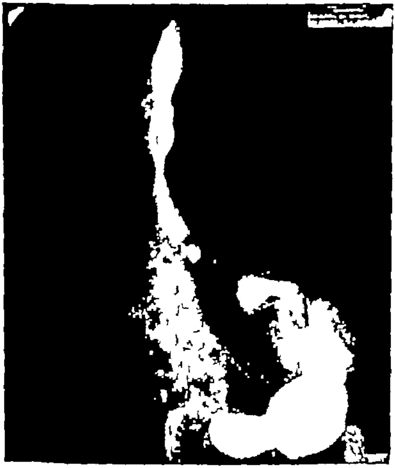

Fig. 6 Case 3 —Roentgenogram showing irregularity of the lower half of the esophagus and active chronic duodenal ulcer on Aug 21 1950

The patient stated that the present illness dated back 20 years In 1941 a small duodenal ulcer had been diagnosed at Peter Bent Brigham Hospital in Boston. He reported frequent bouts of nausea and vomiting and frequent episodes of epigastric pain relieved by feedings Always a high strung person he had worked hard and had had long hours In March 1950 he had experienced severe attacks of epigastric pain with nausea vomiting and hemorrhage from the duodenal ulcer Nevertheless despite the Roentgen findings of August 21 when he consulted me a week later he refused esophagoscopy

Some two months later he experienced five bouts of severe hemorrhage from the *duodenal* ulcer On November 3 Roentgenograms showed a non obstructing duodenal ulcer and a small esophageal hiatal hernia apparently accompanied by shortening of the esophagus The deformity of the duodenal cap was more pronounced than on the previous examination

The patient consulted me on Jan 30, 1952, again complaining of inability to swallow The previous night a piece of meat had obstructed the esophagus completely, and he had been unable to swallow water Roentgenograms taken just prior to my examination showed narrowing of the lower third of the esophagus with impaction of food Atropine, given by the Roentgenologist, had relieved the obstruction. Diagnostic esophagoscopy was again refused

A massive hemorrhage on November 28 necessitated a subtotal gastric resection A chronic constricting ulcer of the duodenum which showed active bleeding was found

In June, 1953, the symptoms of substernal burning and food blocking in the midesophagus became worse especially with emotional stress In July, I was asked to see the patient again because of complete esophageal obstruction for 48 hours Esophagoscopy revealed an orange seed obstructing the esophagus 40 cm from the incisor teeth Distal to this point the esophagus was greatly narrowed and at the site of the stricture there was mild inflammatory change in the mucous membrane The following day it was possible to pass only a No 18 French Hurst dilator Dilatations were continued until October 1953 at which time a No 30 French Hurst dilator was the largest that could be passed Although he has not returned for further dilatations the patient recently stated that he still has difficulty occasionally with solid foods, but gets along well if he chews his food thoroughly and eats slowly

Comment —The relationship between duodenal ulcer, esophagitis, and esophageal stricture is here illustrated The association of emotional stress with each bout of esophageal obstruction and the progression of the symptoms following gastric resection are particularly noteworthy Benedict and Gillespie[5] observed that spasm precipitated by emotional stress superimposed on organic changes accounts for exacerbations in some cases

Case 4 M C D, a white woman aged 63, first consulted me on July 10 1953 Her complaints were dysphagia with inability to swallow liquids or saliva except small amounts occasionally and with food seeming to lodge in the midesophagus, pain radiating to the throat, shoulder and hand on the right side, intermittent pain in the epigastrium on the left side noted especially when she was nervous or upset frequent unpredictable bouts of substernal burning lasting from four hours to several days and frequent constipation There had been no melena

The patient related that severe vomiting during the last two trimesters of a pregnancy in 1933 with vomiting of blood two or three times daily two weeks prior to delivery, marked the onset of symptoms Several days after a normal delivery the vomiting ceased Progressive dysphagia began three weeks later, and within one month she was unable to swallow water Esophagoscopy was performed in Philadelphia Correspondence with her physicians there brought the following report 'An esophagoscopy revealed a lesion in the lower third of the esophagus which was treated as a peptic ulcer of the esophagus She undoubtedly has a short esophagus She had ulceration in the junction of the esophagus and stomach She was treated over a period of five years having several esophagoscopies and dilatations following which she obtained a great deal of relief

Thereafter she experienced dysphagia only occasionally until 1948 when she was hospitalized in New Jersey because of recurring episodes of dysphagia and vomiting associated with nervousness and tension. Her physician there stated that she had had previous gallbladder trouble and that there was evidence suggestive of an ulcer The Roentgen diagnosis at that time was A narrowing of the lowermost 5 centimeters of the esophagus The upper end of the narrowed area was funnel-shaped and smooth. About 2 centimeters above the cardia, there was a small puddling of barium 3 millimeters in diameter which projected from the right wall of the esophagus This was interpreted as an ulcer crater until proven otherwise. The duodenal cap was constantly slightly deformed without the demonstration of an active crater Impression A narrowed esophagus probably represented scarring from previous inflammation, and the deformed duodenal cap was evidence of an old ulcer history

Fig 7 Case 4—No Roentgen evidence of esophageal disease reported on July 10 1953

Correspondence with her physician in New Jersey stated that esophagoscopic examination at that time revealed stenosis of the distal third of the esophagus with some ulceration of the mucous membrane Bougies up to No 24 French were passed with slight difficulty

The patient then moved to Jacksonville Recurrent dysphagia led to hospitalization in 1952 under the care of an internist. Roentgenograms were interpreted as giving evidence of moderate cardiospasm without dilatation, and a deformity of the duodenal cap was attributed to chronic ulcer It was concluded that there was an active ulcer near the base of the cap Despite treatment for duodenal ulcer, dysphagia persisted In June, 1953, she returned to her physician in New Jersey On esophagoscopic examination, he observed a narrowing of the distal third of the esophagus with ulceration of the mucous membrane Attempts at passing bougies were unsuccessful. She was unable to swallow a string His diagnosis was esophagitis with an appreciable degree of cardiospasm and stricture secondary to duodenal ulcer He referred her to me for further treatment.

A barium swallow on July 10 the day she first consulted me resulted in negative findings (see Fig 7), reported as follows 'Examination of the esophagus reveals no evidence of any intrinsic lesion The esophagus is not dilated and there is no cardiospasm at this time The aorta is moderately tortuous and elongated and the esophagus curls around, but there is no evidence of any obstruction"

On August 13 I performed an esophagoscopy At a point just above the gastroesophageal junction there was a narrowing of the esophagus with a horizontal shelf on the right side Beneath this area there appeared to be a stricture with acutely inflamed mucous membrane The esophagus was dilated until a No 21 dilator could be passed with difficulty The following week a No 18 French Hurst dilator was the largest I could pass Subsequent dilatations were carried out over a string at weekly intervals for three months until a No 27 dilator was employed The dysphagia then subsided At present, dilatations are being carried out with a No 24 Hurst dilator at six to eight week intervals and she has experienced no further dysphagia She is now on an ulcer diet and is taking antacids Except for some heartburn associated with nervousness, she is asymptomatic

Comment—In this case there appear to be two contributing causes The sequence of events probably represents an acute reflux esophagitis following vomiting in pregnancy, progressing through the stages of chronic ulceration, fibrosis, and stricture Vinson[48] estimated that 10 per cent of benign esophageal strictures result from the vomiting of pregnancy In all probability the duodenal ulcer is also reactivating the chronic esophagitis from time to time, causing increased stricture formation, esophageal spasm, and symptoms of dysphagia

The lack of Roentgen evidence of esophageal disease in a patient suffering from severe dysphagia is particularly noteworthy here Vinson[48] observed that at times the lumen of a stricture is small enough to impede normal swallowing of solid food and yet large enough to permit passage of a thick paste of barium without apparent delay during Roentgenography If a benign stricture of this type is to be detected he warned, complete examination of the esophagus is necessary when a patient complains of dysphagia Several years ago, in a patient under my care, with carcinoma of the esophagus, three esophagrams gave negative evidence, and the diagnosis was finally established by esophagoscopy Despite normal Roentgenograms, esophagoscopy should be recommended when there is a history of persistent dysphagia

Association with Hiatal Hernia and Shortened Esophagus —Two types of hiatal hernia are described by Allison [3] the paraesophageal and the sliding hernia A combination of the two may exist.

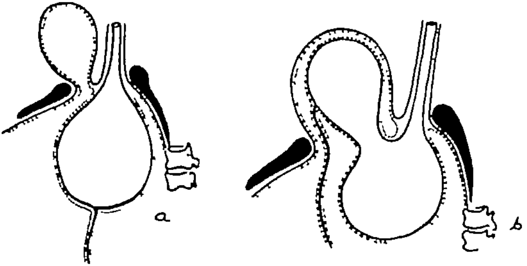

Fig. 8 Preformed peritoneal sac covered by fascia lying in front of the esophagus b Anterior wall of the stomach rolled up into the sac to form a paraesophageal hernia. Redrawn from Allison [3]

A paraesophageal hernia is a herniation of the stomach through a preformed peritoneal sac which always lies anteriorly to the hiatus In some persons a protrusion of the peritoneal sac may remain in the hiatus Allison[3] believed that the hernial sac may remain empty during the patient's entire life, or at any age a part of the anterior surface of the stomach may project into it If the ligaments of the cardia remain strong, the hernial sac can fill only by the rolling up of the anterior wall of the stomach In paraesophageal hernias, the esophagus still enters the stomach at an acute angle, and a dilated stomach when filled lies between the pericardium and the spine compressing the esophagus from before backward preventing regurgitation of gastric contents into the esophagus (see Fig 8) Esophagitis with its symptoms and sequelae does not develop in patients with this type of hiatal hernia, however, they may complain of fulness after meals and shortness of breath

In 158 of 170 cases of peptic esophagitis reported by Schmidt[30] esophageal hiatal hernia, either of the short esophagus or of the sliding type, was present The loss of sphincteric action at the cardia in hernia of these types was highly suggestive of the etiology in this series

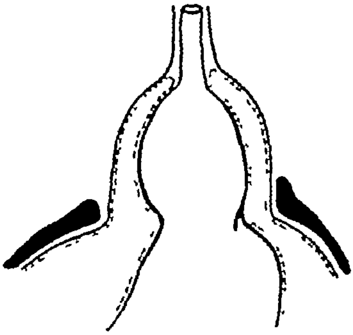

Fig 9 Diagram of the anatomic relations of sliding hiatal hernia. Note the stretching of the peritoneal reflection and the phrenoesophageal ligament Redrawn from Allison[2]

The sliding type of hernia occurs when there is a general weakness of the muscles and ligaments at the cardia The acute angle between the esophagus and the stomach disappears, and the cardia slides up into the mediastinum In the early phase, the esophagus appears shortened because of its elastic recoil Allison[2] stated that during this phase the esophagus is not shortened but only relaxed and may be pulled back into its normal position by slight traction of the stomach at operation The previously described mechanism which normally prevents gastric reflux no longer exists in patients with this type of hernia In many of them peptic esophagitis develops because of the reflux of gastric contents into the lower portion of the esophagus In the early stage they may be cured by a simple reduction of the hernia, as advocated by this author (see Fig 9)

Persistence of the sliding type of hernia leads to the advanced stages of esophagitis including chronic ulceration and stenosis The hernia is no longer reducible, and with continued progression of the disease, a resection of the esophagus may become necessary[3]

Hiatal hernias occur most frequently in the fourth decade of life and later when the tissues about the hiatal orifice are relaxed An increase in intra-abdominal pressure may be a factor It has been suggested that hiatal hernia may be caused by an upward traction of the stomach secondary to a shortening of the esophagus in response to some vagal stimulation Dey, Gilbert, Trump and Roskelley[13] demonstrated a reflex shortening of the esophagus in animals with the production of hiatal hernia due to traction upon the stomach by electrical stimulation of the vagus nerve, or reflexly from stimuli having their origin in the viscera of the upper part of the abdominal cavity

Esophagitis similar to that occurring in the sliding type of hernia is encountered in patients with a congenitally short esophagus Some observers believe this to be a rare condition In many cases, the condition previously diagnosed as congenitally short esophagus probably represents the sequence described by Allison[3] with the shortened esophagus secondary to the loss of the elastic recoil with subsequent maintenance of the retracted position due to scar tissue formation

Case 5 F H., a white executive aged 41 was referred by an internist for esophagoscopy in February 1950 An intense, apprehensive person he had multiple complaints, most of them apparently functional in nature Chief among them was pain in the chest of two or three days duration associated with a choking sensation The pain was fairly well localized under the xiphoid process followed deglutition by a few seconds was dull in character brief in duration and occurred with each act of swallowing Regurgitation of small amounts of food and gastric juice also was associated with pain

For 16 years he had had symptoms consisting of substernal discomfort, a sensation of food blocking in the midsternal region and also regurgitation of acid free food during or shortly after a meal. At intervals of several weeks to several months, episodes of this nature recurred two or three times a week, lasting one to three hours. There was no history of gastrointestinal bleeding or of true vomiting. Cardiospasm frequently had been diagnosed and on several occasions esophageal dilatation had been advised Another complaint was cramping in the midepigastrium 15 to 20 minutes after meals recurring at indefinite periods and with no seasonal relations but always present during periods of strain. Most apprehensive about his throat, the patient was concerned over the possibility of cancer

General physical and otolaryngologic examinations gave negative results except for a hyperactive gag reflex. Roentgen examination on February 6 resulted in a diagnosis of esophagitis, hiatal hernia, and possible ulceration of the esophagus (see Fig 10)

Esophagoscopy on February 11 disclosed an area characterized by inflammatory change 1 5 cm in diameter on the left posterior lateral wall just above the gastroesophageal hiatus Approximately 2 cm above it on the right lateral wall an area of similar size appeared to be inflamed and covered with a whitish exudate Forty five centimeters distal to the incisor teeth a wide hiatus opened directly into the stomach The usual twist of the terminal portion of the esophagus was not noted, and the esophagus appeared to be shortened The gastric mucosa had a normal appearance

Fig 10 Case 5—Roentgenogram showing esophagitis with possible ulceration of the esophagus and hiatal hernia on Feb 6 1950

The patient improved rapidly on an ulcer regimen On February 17 Roentgen examination again demonstrated a congenitally short esophagus with hiatal hernia and esophagitis He was discharged from the hospital to continue treatment at home The final diagnosis was esophagitis, hiatal hernia short esophagus, and severe anxiety state He continued to consult me frequently, complaining of fulness in the throat and a choking sensation and the anxiety about cancer persisted but no abnormalities were noted in the throat.

On Dec. 6 1951 the patient was readmitted with an acute attack of severe pain in the chest. Despite recurrence of symptoms for several months similar to those which occasioned hospitalization early in 1950, he had overindulged in barbecued ribs and cabbage the previous day

His increasing difficulty for some months had more or less paralleled his expenditure of energy in his business affairs. He responded rapidly on an ulcer regimen and rest.

Substernal pain was the chief complaint when he again was hospitalized in June 1954 Several days previously a severe burning pain in the lower subxiphoid region had followed by an hour an evening meal of a ham sandwich coffee and Coca Cola, preceded by a large meal at noon The general physical examination once more gave negative results except for a state of anxiety Roentgen diagnosis was hiatal gastric hernia and possible ulcer crater of the esophagus (see Fig. 11) As previously an ulcer regimen and rest brought improvement.

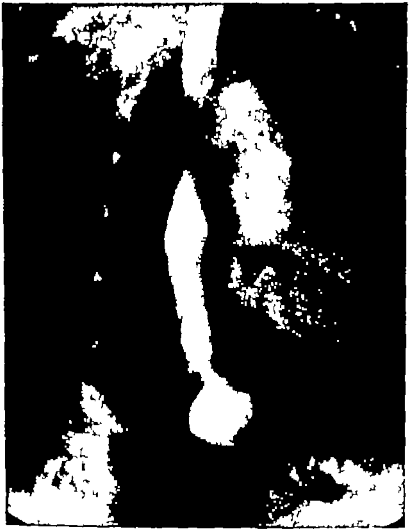

Fig 11 Case 5—Roentgenogram showing ulceration still present on June 4 1954

Comment—The symptoms of choking substernal burning, and food blockage might easily be considered functional in a patient of this type unless the underlying pathologic process is understood Such symptoms merit careful investigation, including a thorough gastrointestinal examination and diagnosis This case illustrates well the pattern described by Allison[29] and others, which includes the association of hiatal hernia, gastric reflux, esophagitis, esophageal ulcer, and probable shortening of the esophagus, which increases the hiatal hernia and reflux

Reflux Esophagitis Secondary to Esophageal Surgery—The dramatic advances in the field of thoracic surgery in recent years have been accompanied by an increased number of operations for cardiospasm and benign stricture of the esophagus An incompetent cardia too frequently follows this procedure, leading to regurgitation of gastric contents into the lower portion of the esophagus with resultant reflux esophagitis The time-proved treatment of these conditions with dilatations should not be discarded, and surgical correction should be used only as a last resort. Increasing esophageal resection for malignant disease has increased the incidence of reflux esophagitis for the same reason

Ripley, Olsen and Kirklin,[36] in evaluating 65 patients who underwent esophagogastrostomy or cardioplasty, found that 28 subsequently had positive signs and 12 had presumptive signs of reflux esophagitis or formation of a stricture They concluded that the development of techniques to prevent this sequela was needed Sweet, Robbins, Gephart and Wilkins[37] in 1954 concluded that if a careful choice of operative procedure is made for peptic ulceration and stricture of the lower portion of the esophagus to suit the conditions encountered in the age and physical status of the patient, a satisfactory clinical result may be anticipated in at least 90 per cent of the patients

Patients subjected to esophageal resection and anastomosis with the stomach and jejunum should be observed closely for symptoms of reflux esophagitis Prophylactic measures, such as sleeping with the head of the bed elevated and the use of antacids for substernal discomfort, are of value An esophagoscopy is indicated when definite symptoms are present.

Case 6 N S J a white woman, aged 50, first came under my observation on June 16, 1950 Her chief complaint was difficulty in swallowing for the past three months, solid food seeming to lodge in the region of the xiphoid process Physical examination gave negative results Roentgen examination of the esophagus demonstrated an irregularity of the lower portion. On June 29 I performed an esophagoscopy and noted a raised ulcerated lesion on the posterior and left lateral wall of the esophagus approximately 30 cm from the incisor teeth The report on the biopsy was squamous cell carcinoma.

The lower two-thirds of the esophagus was resected on July 1 by the referring surgeon A high esophagogastrostomy was performed above the arch of the aorta. The patient made an uneventful recovery She was able to swallow a soft diet without difficulty Four months postoperatively she noted the onset of dysphagia for soft foods Roentgenograms on March 14 1951 showed narrowing of the esophagus at the anastomosis with the stomach (see Fig 12) The next day I performed an esophagoscopy The esophagus was displaced to the left posteriorly and dilated above the anastomosis Retained secretions were present. The mucosa was inflamed but intact The site of the anastomosis was markedly narrowed A No 18 French Jackson dilator was introduced through the stricture with difficulty The dysphagia persisted for three more months A radical dissection of the glands of the neck on the left side then was performed on October 3 by the referring surgeon for a metastatic carcinoma of the supraclavicular nodes Again she made an uneventful recovery

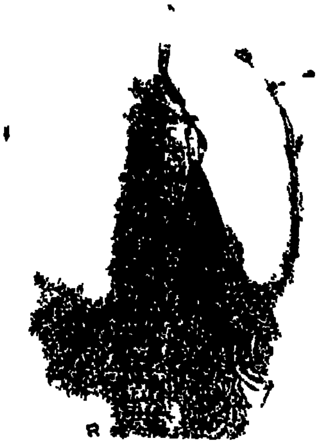

Fig 12. Case 6—Roentgenogram showing narrowing of the esophagus at the anastomosis with the stomach on March 14 1951

Recently the patient stated that she is able to eat anything but onions.

She has no complaints except for constipation and occasional pain in the left side of the chest There is at present no evidence of metastatic disease

Comment—This case is presented to show the development of acute reflux esophagitis following esophagogastrostomy

Case 7 M B, a Negro woman, aged 48 was referred on May 28, 1954, with the complaint of difficulty in swallowing The referring surgeon had performed a total gastrectomy splenectomy, and partial esophagectomy with an esophagojejunostomy on the preceding March 22 for a carcinoma of the esophagus involving the lower one-third of the esophagus and extending down to the cardia. The lower two-thirds of the esophagus was resected and the anastomosis made above the arch of the aorta The neoplasm was a squamous cell carcinoma, Grade 4, with extension to the gastric and paraesophageal nodes on the left side The patient had experienced gradual progressive dysphagia for four months prior to the surgery A barium swallow revealed almost complete obstruction of the esophagus 6 cm above the diaphragm The surgeon noted a poor blood supply of the jejunum manifest by a bluish discoloration at the site of the anastomosis with the esophagus

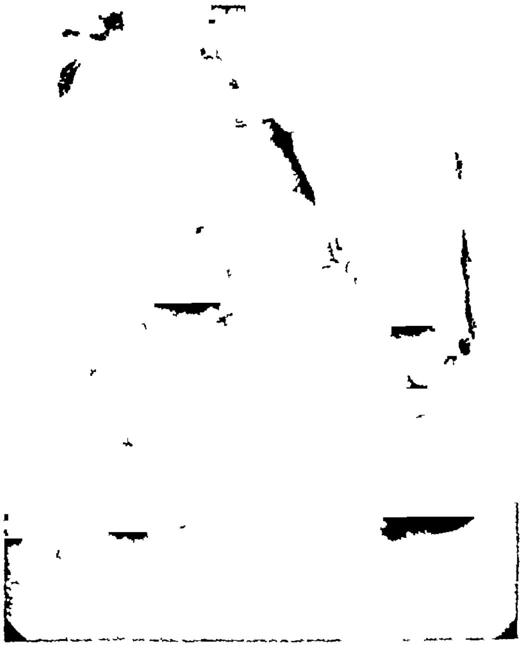

Fig 13 Case 7—Roentgenogram showing narrowing of the esophagus at the anastomosis with the jejunum on June 3 1954

For six weeks postoperatively the patient swallowed with little difficulty Progressive dysphagia then developed, and she complained of epigastric pain There were intervals of improvement, but the dysphagia persisted Roentgenograms on June 3 gave evidence of narrowing of the esophagus at the anastomosis with the jejunum (see Fig 13) On June 6 I performed an esophagoscopy The esophagus showed pronounced inflammatory change from just below the cricopharyngeal pinchcock to the site of the anastomosis, where it was markedly narrowed It was difficult to pass a No 12 French Jackson dilator through this narrowed area. The mucosa was ulcerated and friable and bled easily upon manipulation My diagnosis was acute esophagitis. The course was progressively down hill and she died of generalized carcinomatosis on June 24 Microscopic section of the esophagus revealed severe esophagitis but no recurrent neoplasm.

Comment—Severe esophagitis in this instance followed esophagojejunostomy The poor blood supply of the jejunum may have been an etiologic factor, but it is doubtful that this would account for the esophagitis above the anastomosis This case would suggest that reflux of intestinal juice is also capable of causing a reflux esophagitis

TREATMENT

The majority of patients manifesting symptoms of reflux esophagitis respond to conservative therapy It is of utmost importance that the symptoms be recognized and the diagnosis established early before the disease has progressed to its later stages Medical therapy in the early cases consists of antacids, antispasmodics, good oral hygiene, and abstinence from alcohol The patient should sleep with the head of the bed raised 8 to 12 inches to prevent nocturnal gastric reflux and should continue to do so after the symptoms have subsided

Since the esophagus is at rest normally except during deglutition, Carver and Sealy[10] advocated three large liquid or semisolid feedings daily in order to decrease esophageal peristaltic activity They condemned the use of multiple bland diet feedings as used in the treatment of gastric or duodenal ulcers, while such a diet neutralizes gastric juices, it also stimulates gastric motility and the production of more hydrochloric acid and pepsin Thus, more frequent feedings increase esophageal peristaltic activity They advocated a glass of water after each meal to clear the lower part of the esophagus of food particles Also, they prescribed a liquid antacid to be taken at the earliest sign of substernal discomfort and at night before retiring

Atropine administered 30 minutes before meals will reduce spasm and gastric secretions Antibiotics may be used parenterally or orally for secondary infection Rogers[37] prescribed 0 5 Gm of streptomycin in 5 cc of saline solution to be taken two to four times daily Gentle bouginage may be carried out for spasm or early stenosis Carver and Sealy[10] advocated continuing treatment until the patient is free of pain for at least two weeks, three consecutive stools show no occult blood, and Roentgenograms show no evidence of an ulcer crater or delay of barium passage through the lower third of the esophagus A bland diet should be taken for two or three months after symptoms have subsided

Allison[2] favored a repair of the diaphragm in patients with a sliding hiatal hernia before a permanent esophageal shortening has occurred This restores the normal cardioesophageal mechanism and prevents the progressive phases of reflux esophagitis

Chronic ulceration and stricture are manifest by the symptoms of dysphagia In addition to conservative management, a program of bouginage must be instituted This is best carried out by dilatation over a string When sufficient dilatation is obtained by dilating over the string, Hurst mercury-filled bougies may then be employed The patient may be taught to dilate the esophagus himself with these Dilatations are begun at weekly intervals, and the interval is increased as soon as possible Too frequent dilatations may prevent healing and increase spasm In severe cases temporary gastrostomy and retrograde dilatations may be necessary Gastrostomy is advantageous in maintaining an adequate nutrition and placing the esophagus at rest[10]

Sweet, Robbins, Gephart and Wilkins[43] advocated surgical measures in any case of ulcer or stricture of the esophagus in which there is a history of bleeding, *obstruction* unsuccessfully treated by bouginage, intractable pain, or in some instances evidence of perforation They concluded that if a careful choice of operative procedure is made to meet the conditions encountered and the age and physical status of the patient, a satisfactory clinical result can be anticipated in at least 90 per cent of the patients Operative procedures advocated by them were a limited esophageal resection with end to end anastomosis, esophagoplasty, and partial esophagectomy and gastrectomy with an esophagogastro anastomosis Carver and Sealy[10] preferred subtotal gastric resection with repair of hiatal hernia for the treatment of patients with a triad of esophageal ulcer, hiatal hernia and duodenal ulcer Wangensteen and Leven[52] believed that the merit of gastrectomy as a therapeutic agent for the relief of esophageal obstruction secondary to ulcer disease is that it reduces the acidity and digestive capacity of the gastric juice and quickens the gastric emptying time.

Benedict and Gillespie[5] stated that gastric resection for esophageal stenosis and the presence of duodenal ulcer is theoretically justified so far as it reduces the volume of gastric secretion, but there is inadequate evidence of its prophylactic or curative value at present. They concluded that it is desirable to repair hiatal hernias that are causing symptoms and do not respond to other measures, but believe there is inadequate evidence at present to prove the value of repair operations as a prophylactic measure

COMMENT

Recognition of the early symptoms of reflux esophagitis is important if the progress of the disease is to be prevented Familiarity with the closing mechanism of the esophagocardiac junction is essential to the understanding of this disease Impaired function of this mechanism allows a reflux of gastric contents with a high acid pepsin concentration to have a corrosive effect on the esophageal mucosa The devastating effect of the action on the nonresistant squamous mucosa of the lower portion of the esophagus has been demonstrated experimentally This process causes an acute erosive esophagitis to develop, which progresses in the absence of medical management to an acute ulcerative esophagitis with subsequent destruction of the muscularis coat, which finally terminates in a cicatricial stenosis of the esophagus Hemorrhage and perforation may occur as complications The symptoms of reflux esophagitis associated with sliding hiatal hernia duodenal and gastric ulcer, congenitally short esophagus and vomiting, and those occurring postoperatively deserve careful investigation on the part of the physician if this disease process is to be arrested One should be most hesitant before labeling such complaints as functional

Diagnostic procedure should be advocated early and medical management instituted as soon as the diagnosis is established The majority of the patients with reflux esophagitis respond to medical management Repair of sliding hiatal hernia is advocated if medical management fails in cases of this type[2] Surgical intervention is advised in cases of ulcer or stricture of the esophagus when there is a history of bleeding, obstruction unsuccessfully treated by bouginage, intractable pain, or evidence of perforation[13] In spite of normal Roentgen findings, diagnostic esophagoscopy should be performed when unexplained symptoms pertaining to the upper part of the gastrointestinal tract persist

SUMMARY

The anatomy and physiology of the esophagus, particularly of the lower portion, are described

The etiology of esophagitis due to reflux of gastric contents into the lower portion of the esophagus is discussed Seven cases are presented and commented on to illustrate various causes of reflux esophagitis

The pathologic changes, symptoms, diagnosis and medical and surgical management of this disease are presented briefly

Esophagoscopy is of the utmost importance in the final diagnosis and understanding of this disease

It is essential that the otolaryngologist be well aware of the symptoms, the characteristic pathologic changes, and the sequelae of reflux esophagitis

Likewise, the internist, the surgeon and the general practitioner all may benefit by familiarity with the various aspects of this disease so that early recognition and remedial measures may combat both the disease and a tendency among physicians to regard its initial manifestations as functional in nature

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TRACHEOBRONCHIAL INVOLVEMENT SECONDARY TO PULMONARY TUBERCULOSIS

The Role of the Bronchoscopist in Its Management.*

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FOREWORD

This thesis has for its purpose an analysis of the role of the bronchoscopist in pulmonary tuberculosis, with particular reference to involvement of the tracheobronchial tree, and also with particular reference to his function in a tuberculosis section attached to a large general hospital

This purpose has been accomplished in two ways

1 By a review of 200 recent bronchoscopies performed on tuberculosis subjects in a hospital of this kind

2 By a review of the literature, including a review of the more important of the early publications on bronchoscopic diagnosis of tracheobronchial involvement in pulmonary tuberculosis Special features of the 200 cases analyzed are discussed in the light of this review.

HISTORICAL NOTE.

In an interesting and excellent review of the development of the concept of tracheobronchial tuberculosis as a complication of pulmonary tuberculosis, Smart[1] pointed out that the earliest mention of tuberculous lesions in the tracheobronchial tree was by Richard Morton in 1694, the same Morton, incidentally, who originated the word phthisiology The condition was so well described by Cayol in 1810 that his thesis on the subject was referred to in complimentary terms by Laennec in 1829, in *Mediate Auscultation and Diseases of the Chest*

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Although Laennec thought the complication unusual, he devoted several pages to bronchial ulceration, stenosis, wheeze and rhonchi were described as characteristic.

Meantime Louis, in 1825, had given an excellent description of the appearance of bronchi in the neighborhood of tuberculous cavities and had also described tuberculosis of the larynx, the epiglottis and the trachea. There were only seven cases of tracheobronchial tuberculosis in the 102 cases of pulmonary tuberculosis on which his remarks were based, but the incidence of bronchial involvement would probably have been greater, as he stated, if his examination of these structures had been more detailed

In spite of the excellence of these early descriptions, clinicians were not greatly impressed by possible involvement of the tracheobronchial tree in pulmonary tuberculosis. Stokes in 1837, in *Diseases of the Chest*, stated that he would not occupy many pages with this subject because it was "of more interest to the pathological anatomist than to the student of diagnosis." More than a hundred years later, in 1938, Warren, Hammond and Tuttle[4] observed that there was no better example in clinical medicine of slowness to grasp the observations of the pathologist and turn them to use than tracheobronchitis, which had for so many years remained "a textbook legend"

To continue with Smart's account, Rokitansky in his textbook of pathology published in 1842 gave a good description of the relation of endobronchial ulceration to cavitation. Heinze, in 1879, found an 8 per cent incidence of tracheal involvement in 1,226 cases of pulmonary tuberculosis He did not investigate the bronchi Eppinger the following year described the type of miliary laryngeal and tracheal tuberculosis which exists without pulmonary cavitation All of these descriptions, as several observers have noted, antedated the discovery of the tubercle bacillus by Koch in 1882.

After this period, as Smart puts it, tracheobronchial tuberculosis "passed into considerable neglect." It was mentioned only occasionally during the next 40 years, and it seems to have received no clinical consideration at all.

Interest in it was revived in 1924, when Heaf[3] published a study of tuberculous lesions in the trachea, they were found in 44 per cent of 133 autopsies performed in tuberculosis subjects at the Colindale Hospital in Hendon He gave an excellent clinical description of tracheal involvement but did not mention bronchial lesions In 1929 Minkovsky,[4] in an analysis of 2,584 autopsies on tuberculous subjects at a hospital in Leningrad, reported that the larynx was involved in 19 per cent of all cases and the trachea in 11 4 per cent Like Heaf, he made no mention of bronchial involvement.

Interest in tuberculous lesions of the bronchial tree in pulmonary tuberculosis was a development of the next few years At first it was limited almost exclusively to the United States It was not until 1939, as Smart points out, that the first paper on the subject, by Morlock and Hudson, appeared in the British medical literature Young,[5] in 1953, doubted that tracheobronchial tuberculosis had been of great importance in Great Britain 30 years earlier and suggested that the current incidence might indicate a change in the pattern of the disease Smart's reasoning seems more logical When bronchoscopies began to be performed in considerable numbers in Great Britain, he said, the disease promptly became as common there as it was in the United States

An interesting comment on the comparative incidence of tracheobronchial disease in the two countries was made by Jarman[6] in 1949 Although he was then practicing in Wales, his experience with the disease had been obtained at a sanatorium in Michigan Lesions of the major bronchi were diagnosed so much more often in the United States than in Great Britain, he said, that the question had arisen whether they were being over-diagnosed in the former country and under-diagnosed in the latter Without committing himself as to possible under-diagnosis in the United Kingdom, he stated that his personal American experience had convinced him that they were not being over-diagnosed in the United States, in which because of racial and geographic factors, they might perhaps be really commoner

The classic reports of Eloesser, Samson and their associates on tracheobronchitis are still worth reading Their concepts, however, were slow to spread In 1934 Eloesser[7] wrote that stenosis of the larger air passages was "the stepchild of clinical medicine" In 1937 Samson[8] complained that the literature to date had chiefly been devoted to the obstructive variety of tracheobronchitis and that the clinical recognition of the earlier, non-obstructive manifestations of the disease was still being seriously neglected It is a tacit commentary on the general unfamiliarity with the condition that a year earlier the *American Review of Tuberculosis* had provided space for the publication of 18 detailed case histories of tracheobronchial tuberculosis.[9]

The continued ignorance of the disease might have been expected Most of the early reports were derived from post-mortem material and contained little of interest, it was thought, for the clinician, furthermore, tracheobronchial tuberculosis can be diagnosed positively only by the bronchoscope, and bronchoscopy in pulmonary tuberculosis had not yet been generally accepted Half a dozen recent writers have commented on the fact that as late as 1927 Chevalier Jackson, the father of bronchoscopy in this country, stated that it was of no great use in tuberculosis Myerson[10] in 1936 remarked that the "most authoritative work on bronchoscopy" (presumably Jackson's text) gave only a page to the use of the bronchoscope in tuberculosis. One writer stated that some observers 'even advocate it' in the absence of any suspicion of tracheobronchial disease, merely because thoracoplasty was to be performed. One gathers from what was left unsaid, rather than from what was said, just how daring that policy was.

By 1944, however, the situation had begun to change In that year a symposium on tracheobronchitis was held at the annual Congress of the American College of Chest Physicians, and the January-February, 1945, issue of *Diseases of the Chest* was given over entirely to the publication of the proceedings[11] Stone, in the introduction to this special issue, wrote "Is it too much to hope that the future chest specialist will not only be expert with his stethoscope, X-ray interpretations and clinical evaluation, but that he will also be adept with the bronchoscope?"

At this symposium Overholt and Wilson[12] presented what they called a preliminary report on pulmonary resection in tuberculosis complicated by tuberculous bronchitis The two significant developments in pulmonary tuberculosis in the past decade, they said, were *1,* the knowledge that had been gained concerning tuberculous tracheobronchitis, and *2,* the accomplishment of lobectomy and pneumonectomy in tuberculosis with such a margin of safety that resectional surgery had now to be considered in all therapeutic programs They might have gone further and said that underlying the increased knowledge of tracheobronchial tuberculosis was the increased use of bronchoscopy, which had made its recognition possible.

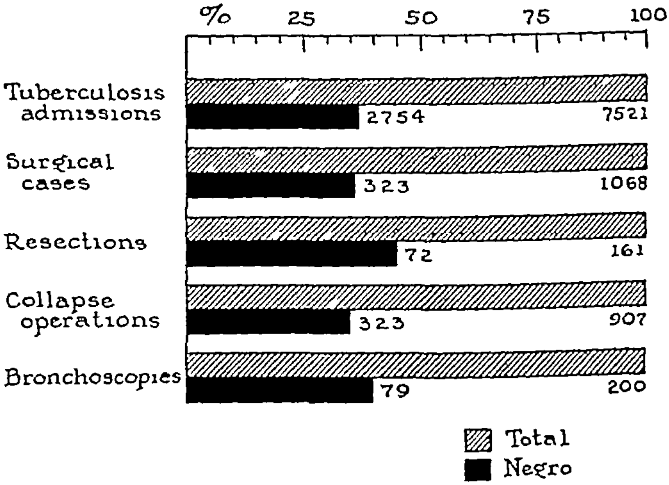

Fig 1 Tuberculosis at Charity Hospital 1946-1953 with special reference to the negro general data

MATERIALS AND BACKGROUND

The 200 bronchoscopies which form the basis of this thesis were performed on tuberculous subjects at Charity Hospital of Louisiana in New Orleans, between 1946 and 1953 inclusive This hospital does not operate a sanatorium in any sense of the word, but as a matter of necessity it has always had a large tuberculous population The policy of admission, which is adhered to as strictly as possible, is to accept only patients with active disease, who conceivably would respond to therapy

The large negro population (see Fig 1) presents innumerable special problems peculiar to this hospital and this part of the country These problems are particularly urgent in tuberculosis, a disease of high incidence in this race Although the negro admissions to the hospital now far outnumber the white, the physical facilities for negro tuberculous subjects are somewhat less than for the white (see Fig 1), and the turnover of beds is smaller because, in the opinion of those in charge of the tuberculosis units, the negroes, case for case, present more serious disease than white subjects

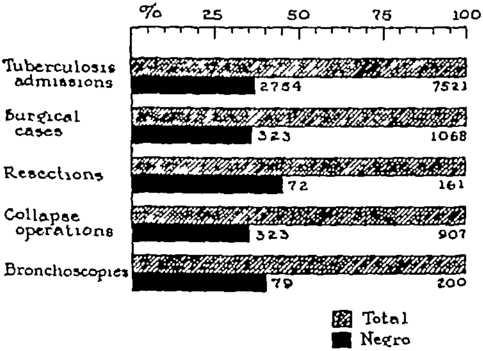

Fig — Tuberculosis at Charity Hospital, 1946 1952 with special reference to the negro surgery

The proportion of surgery performed in the negro unit (see Fig 2) is practically the same as the proportion of negro admissions to the hospital for tuberculosis but the proportion of resections is higher, which is in line, it would seem, with the greater seriousness of the disease in this race. Both the general hospital mortality for tuberculosis and the surgical mortality are also proportionately larger in the negro race (see Fig 3)

As these figures indicate pulmonary tuberculosis is still providing a large number of hospital admissions It is still attended with a high hospital death rate, and the hospital deaths, of course, represent only a small proportion of the total death rate This is particularly true of negroes, for whom hospital facilities for tuberculosis are totally inadequate in this special area The local situation reflects the national situation According to Bureau of Census Reports,[13] there were 34,102 deaths from pulmonary tuberculosis (unqualified) in 1949, 29,228 in 1950, and 26,644 in 1951 That the concept of tracheobronchial involvement in pulmonary tuberculosis is still not general is shown by the fact that during these three years only 35 deaths were listed as due to "tracheobronchial glandular tuberculosis with *symptoms* "

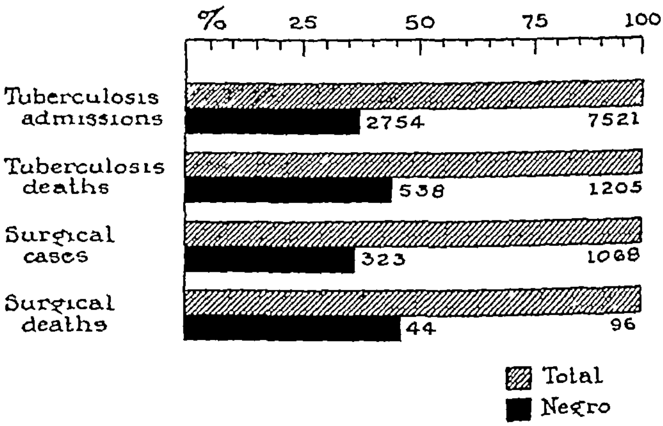

Fig 3 Tuberculosis at Charity Hospital 1946-1953 with special reference to the negro mortalities

INCIDENCE

Eloesser[7] said in 1934 that stenosis of the major bronchi was so frequent in pulmonary tuberculosis that it was difficult to understand how the condition had escaped attention for so long At that time there was certainly no understanding of the true incidence of tracheobronchial involvement in pulmonary tuberculosis Epstein and Ornstein,[14] in 1936, pointed out that Myerson, in 1929, had said that bronchial involvement in tuberculosis was probably not infrequent, but involvement of bronchi accessible to endoscopic study was in his opinion very infrequent. They also cite Clerf's statement in 1931, that involvement of the mucosa of the larger bronchi was apparently rare In 1935 Graham[16] stated that he had never found involvement of the major bronchi in any of the cases he had bronchoscoped, and slightly less space is devoted to tracheobronchial tuberculosis in his text on surgical diseases of the chest than to syphilis of the tracheobronchial tree.

Even in 1954 the true incidence of involvement of the trachea and bronchi in pulmonary tuberculosis is still far from clear One thing, however, is very clear although the importance of this complication is now generally accepted, its frequency is still greatly underestimated The reason is a sort of vicious circle, because the frequency of the complication is underestimated, bronchoscopy is not employed as often as it should be. Because bronchoscopy is employed less often than it should be, the frequency of the disease is not appreciated.

One reason why the reported frequency varies so widely is that the reported series are made up on widely different bases (see Table 1) All stages of the primary disease are represented in them Some reports include laryngeal as well as tracheobronchial involvement. Some are based on routine admissions, others on cases referred for bronchoscopy because of suspicion of the disease Still other reports are based on postmortem studies, which were probably not always conducted by the same techniques.

Flance and Wheeler,[17] who reported the lowest autopsy incidence, stated that they had studied the tracheobronchial tree down to the third order of bronchi, with special care. Daly and his associates,[14] whose study covers only children, consider that diagnostic acumen plays a part in the reported frequency Thirty of the last 90 children whom they bronchoscoped were found to have endobronchial disease, and they regard this proportion (33 3 per cent) as probably more representative than the 10 per cent incidence in their total series of 434 patients

The best of the recent reports, and in many respects one of the best ever made, is by Houghton and Joules,[18] on clinical material collected under the auspices of the British Tubercu-

TABLE 1 — INCIDENCE OF TRACHEOBRONCHIAL TUBERCULOSIS IN VARIOUS REPORTED SERIES

Year	Authors	Source of Material	Cases Studied	Tracheobronchial Disease	Percentage
1939	McIndoe et al[16]	Majority admissions	272	30 positive 13 questionable	11 0
		Autopsies	285	9	3 2
1939	Flance and Wheeler[17]	Selective*	516	132	25 6
1939	Hawkins[18]	Selective	100	31	31
1938	Myerson[19]	Selective	236	52	22 0
1940	Myerson[20]	Autopsies	500	177	35 4
1942	Wilber**[21]	Selective	279	83	29 7
1945	Acuna[22]	Autopsies	110	66	60 0
1945	Silverman[23]	Selective	800	206	25 7
1949	Jarman[8]	Selective***	434	43	10 0
1952	Daly et al[24]	Resected specimens	602	122	20 3
1953	Olson et al[25]	Admissions****	386	131	33 9
1954	Houghton and Joules[26]	Resected specimens	95	39*****	41 0
1954	Candidate	Selective	200	66	33 0

* Bronchoscopies, performed on referred patients

** This material apparently overlaps Myerson s material from the same institution (Sea View)

*** Children only

**** Every fifth admission in six cooperating hospitals

***** 39 cases were positive bronchoscopically When the specimens were examined histologically, the number of cases with tracheobronchial involvement rose to 90 losis Association Eight hospitals cooperated, including two in which the study was limited to surgical cases In the other hospitals, every fifth patient admitted was selected for bronchoscopy, regardless of the status of the disease or any other consideration As far as possible, the bronchoscopies performed in each hospital were performed by the same operators. All reports were made on the same uniform simplified basis, and the laboratory studies of surgical specimens were conducted according to uniform techniques.

In the 386 cases thus studied at six English hospitals, tracheobronchial disease was diagnosed in 131 — 33 9 per cent. This is probably a fair average. It almost precisely parallels the 33 8 per cent incidence reported in this thesis from the Charity Hospital in New Orleans, La The wide range of positive cases at the various English hospitals is more conveniently discussed under the heading of clinical diagnosis For the same reason the histologic studies in the Houghton and Joules report are also discussed under another heading

INCIDENCE IN RELATION TO RACE, SEX AND AGE.

The negro incidence of tracheobronchial disease in this series (see Fig 4) was higher than the white — 39 per cent to 28 9 per cent. This series is small, but the higher negro incidence is significant to those who are familiar with the special problems of pulmonary tuberculosis in this race. The same comment holds for the sex incidence in the two races (see Fig 4) In the 43 negro women who were bronchoscoped the percentage of tracheobronchial disease was 41 6

What little the literature contains on the subject of tracheobronchial disease in negroes generally bears out the observations at this institution, though no other hospital has so large a proportion of negroes in its population. Wilber,[11] who pointed out that her observations were the first on the subject, found tracheobronchial disease at Sea View Hospital in 95 of 180 postmortem examinations in negroes against 111 of 291 examinations in white subjects The hospital admissions for the period covered by the autopsy study were preponderantly white (3 784 against 1,678)

Daly and his associates,[24] in their studies on children at Bellevue Hospital, found tracheobronchial disease in 18 of 144 negroes, against 19 of 165 Puerto Ricans, and 6 of 121 white children. Himelstein,[27] who cites no figures, states that tracheobronchial disease is more common in negroes, aborigines and teen-agers because of the higher incidence of exudative disease in these groups.

The internists at the Charity Hospital report a high incidence of exudative disease in their negro patients. Silverman,[23] at the Triboro Hospital, found no correlations in age, sex or race in 66 cases of tracheobronchial disease diagnosed at postmortem, but there were only 13 negroes in the 110 autopsied cases from which these conclusions were drawn.

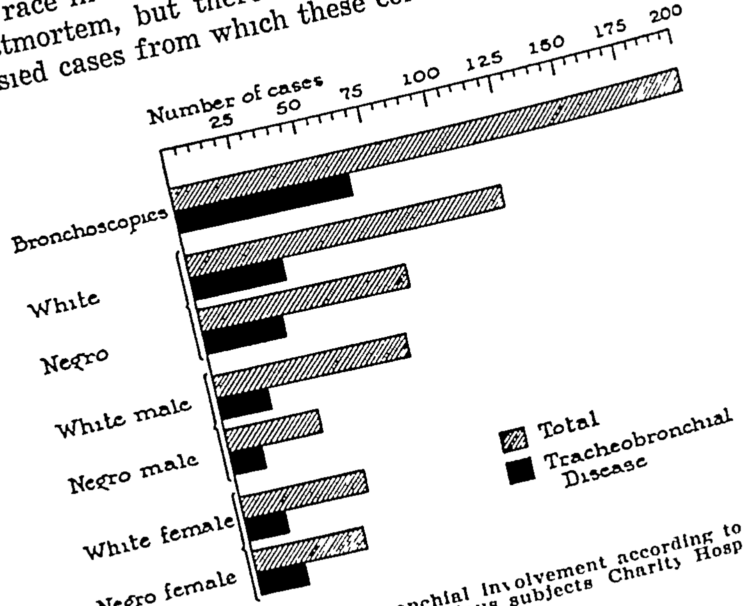

Fig. 4. Incidence of tracheobronchial involvement according to race and sex in 200 bronchoscopies on tuberculous subjects. Charity Hospital 1946-1953.

Most reports show, as does this series, a higher incidence of tracheobronchial disease in females, though no special observations seem to have been made on negro females. Some observers attribute it to the breakdown of tuberculous tissue which is frequent during pregnancy. Himelstein[27] explains it by the smaller caliber of the female bronchus, and recalls Jackson's observations that encroachment on the lumen of the female bronchus, even though it is of small magnitude, can produce distal disturbances out of all proportion to the degree of narrowing

Endobronchial disease can occur at any age, the wide spread observed at the Charity Hospital (see Fig 5) being apparent in all reported series In Wilber's[31] studies from Sea View *Hospital*, for instance, the age range in 177 cases of tracheobronchial disease was from one to 79 years The highest incidence was in the third decade, in which the largest number of autopsies were performed

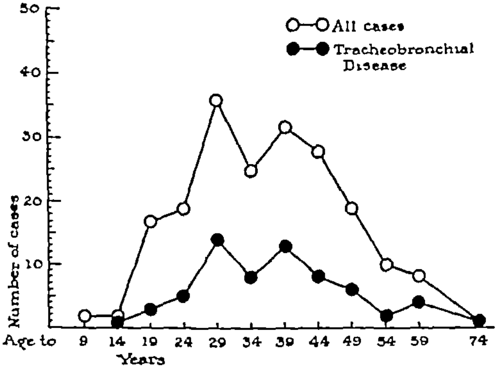

FIG 6 Incidence of tracheobronchial involvement according to age in 200 bronchoscopies on tuberculous subjects, Charity Hospital, 1946 1953

In the study on children by Daly and his associates[14] at Bellevue Hospital, the age range was from four months to nine years, 48 4 per cent of the 484 children in the whole series were under three years of age, but 69 8 per cent of the bronchial involvement was in this group No special observations seem to have been reported on age in negro subjects.

INCIDENCE IN RELATION TO DURATION OF SYMPTOMS.

The duration of the disease is sometimes stated to be a factor in the incidence of tracheobronchial disease. An analysis of the bronchoscopies performed for pulmonary tuberculosis at the Charity Hospital does not support this point of view (see Fig 6) Tracheobronchial involvement appeared in patients who had symptoms of the disease less than a month, as well as in those who had it for 18 years

The chief significance of these observations is that tracheobronchial involvement is not infrequent and must not be overlooked in early cases of pulmonary tuberculosis They are borne out by other reports Overholt and Wilson,[12] for instance, found the duration in 30 cases in which resection was performed, to be from seven weeks to 18 years, nine patients had been ill less than a year Meissner,[28] apparently including the

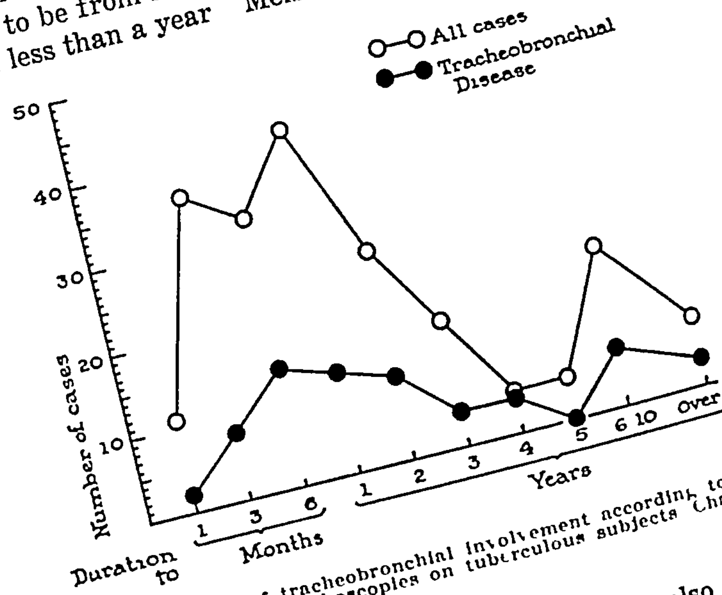

Fig 6 Incidence of tracheobronchial involvement according to duration of symptoms in 197 bronchoscopies on tuberculous subjects Charity Hospital 1946-1953

same material in a larger series (60 cases), also found the duration in a third of the cases to be less than a year

INCIDENCE ACCORDING TO LOCATION OF LESION

The location of the lesions of tracheobronchial involvement in the 66 bronchoscopically positive cases (see Fig 7) cannot be correlated with the location of the parenchymal disease, which was as follows Diffuse involvement of the right lung, 51 cases, and of the left lung, 56 cases, right upper lobe, 95 cases, left upper lobe, 37 cases, right middle lobe, 3 cases, right lower lobe, 6 cases, left lower lobe, 4 cases Parenchymal disease was present in the right lung in 153 cases and in the left lung in 97 In the 66 cases of endobronchial disease, the involvement was on the right side in 44 cases and on the left in 33 These figures, all of which are overlapping, include the 47 bilateral parenchymal lesions and the 11 bilateral tracheobronchial lesions

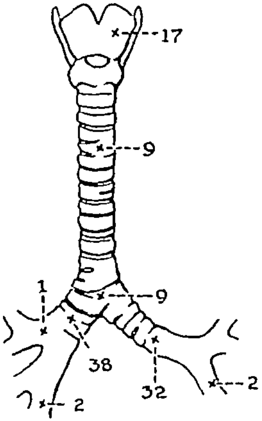

Fig. 7 Anatomic distribution of tracheobronchial involvement of 66 bronchoscoped tuberculous subjects Charity Hospital, 1946 1953

In this series, as in most reported series, it was generally true that unilateral endobronchial involvement was almost always present on the same side as the parenchymal lesion or, if the involvement was bilateral, the endobronchial lesion was more advanced on the side of the unilateral parenchymal lesion. Bilateral endobronchial disease was not necessarily associated with bilateral parenchymal disease, and vice versa These cases also demonstrated, as Myerson[20] has pointed out, that relatively few bronchoscopic examinations are done early enough to be certain of the particular branch bronchus from which the infectious process spread.

PATHOGENESIS.

There are two theories as to how tracheobronchial involvement develops in pulmonary tuberculosis

1 Reichle and Frost[29] in 1934 advanced the theory that infection probably spreads to the bronchi and trachea by way of the lymphatic system By this theory, to express it as simply as possible, the lymphatic structures surrounding the major bronchi and the trachea absorb infected material from the periphery of the lung and carry it through the walls of the bronchi, and thence into the mucosa This is of course a perfectly reasonable mode of infection, but Meissner[28] believes that if it occurs, the tracheobronchial disease will present as gross lesions only at certain selective sites along the path of progression

2 Bugher, Littig and Culp,[30] in 1937, while granting that invasion from peribronchial structures may occur by direct extension in some cases, advanced the counter theory that in most cases infection is by surface implantation. This seems the most obvious possibility Reichle and Frost,[29] while they do not eliminate this mode of infection, consider that it is usually prevented by the protective influences of cilia, mucus and bronchial peristalsis In their opinion, if surface implantation occurs at all it is only after massive eruptions of caseous material They also believe that this form of infection is chiefly limited to secondary bronchi of a lower lobe, which is the seat of bronchogenic distribution from a large apical cavity

The general experience does not support Reichle and Frost's views Most observers believe that implantation infection is the overwhelming mode of extension They also believe that it may occur in any part of the respiratory tract, and is not limited to the lower lobe The site of predilection, for mechanical reasons, is the posterior or posterolateral wall of whatever bronchus may be involved

Infection by contiguity is an obvious possibility whenever a cavity in the lung is adjacent to a major bronchus Few observers, although the possibility naturally exists, consider hematogenous spread of any real significance There also seems little ground for the assumption that tracheal lesions are secondary to laryngeal lesions Both, instead, probably take their origin from the original pulmonary parenchymal disease

BRONCHOSCOPIC OBSERVATIONS

Samson,[8] one of the earliest workers in the field of tracheobronchial involvement in pulmonary tuberculosis, listed four types of lesions observed bronchoscopically and noted that they might exist in combination Bronchoscopic studies at the Charity Hospital indicate that his classification is still valid and sound (see Fig 8) It is as follows

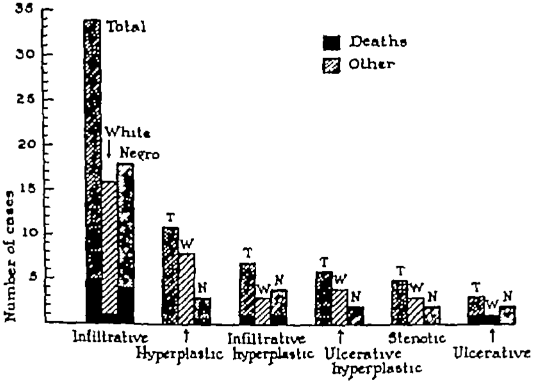

Fig 8 Distribution of pathologic processes in 66 bronchoscopically diagnosed cases of tuberculous tracheobronchitis, Charity Hospital 1946 1953

1 The nonulcerative, nonstenotic type of lesion is an infiltrative process in the submucosa, characterized by the presence of occasional discrete tubercles. The overlying mucosa, while not grossly ulcerated, is congested, granular and edematous and bleeds easily

2 In the hyperplastic type of lesion the pathologic changes are similar to those just described but are greater in degree The submucosal process is proliferative, and conglomerate tubercles or tuberculomas are often demonstrable In this type of lesion there is beginning encroachment on the lumen, sometimes of considerable extent.

3 The ulcerative type of lesion is characterized by grossly visible circumscribed or diffuse loss of mucosa Pyogenic infections are frequently superimposed

4 In the fibrostenotic type of lesion, stenosis may be localized or diffuse While the preceding process may have been proliferative or even infiltrative, it has most often been an ulcerative process which has healed with the formation of fibrous tissue Stenotic lesions were surprisingly few in this material, but in one of the cases it was possible to determine that the antecedent disease had been infiltrative, hyperplastic and ulcerative

The comments of some observers on the pathologic process as it is determined bronchoscopically might be mentioned Himelstein[27] points out that if, as Meissner says, the earliest lesion is a submucosal tubercle, it is logical that the earliest visible manifestation would be an infiltrative edema, which might present as an obliteration of the normal depressions between the cartilaginous rings Himelstein also observes that it is not usual to find ulceration taking the form of the ordinary punched-out, circumscribed lesion When such a lesion is present it indicates, in his opinion, an overwhelming infection by surface implantation

Overholt and Wilson,[12] basing their remarks on a study of 30 resected specimens, stated that the predominant pathologic process is submucosal involvement with round-cell infiltration, usually accompanied by tubercle-formation Wilber[21] considered ulceration the definitive lesion, it was present in his series in 177 of 248 autopsied cases In children, according to Daly and his associates,[24] the first pattern of disease may be bronchial compression without mucosal involvement Edema and inflammation may precede ulceration and granulation Erosion of the bronchial wall by infected lymph nodes is a possibility in children, as might be expected, but is uncommon in adults, also as might be expected

Wilson[31] emphasizes that the first evidence of a stenotic lesion is likely to be stagnation of secretions Even when there is no demonstrable stenosis, loss of ciliary action and decreased bronchial peristalsis result in their clinging to the bronchial wall, where they may be mistaken for tubercles A practical method of determining the nature of these patches is by the use of suction, secretions will disappear while tubercles will remain.

Interpretation of Bronchoscopic Observation The cardinal consideration for the bronchoscopist to bear in mind in studying pulmonary tuberculosis, as well as all other diseases, is that gross appearances are often deceptive, and that an apparently normal bronchus may actually be the site of an extensive disease process. In other words, useful as this technique is, it has definite limitations.

The first of these limitations is that the bronchoscopist is limited by the physical range of his vision He cannot see more, in the order of their visualization, than the following structures

1 The larynx.

2 The trachea.

3 The carina and bifurcation.

4 On the right, the main bronchus, the orifice of the right upper lobe bronchus, the orifice of the middle lobe bronchus, the five segmental orifices of the lower lobe.

5 On the left, the main bronchus, the orifice of the left upper lobe bronchus, the four segmental orifices of the lower lobe.

Within these visual limitations, the bronchoscopist can see changes in the mucosa, dilatation of the lumen and distortion and other alterations in the lumen. Clearly obstructing lesions, which are the cause of stenosis and subsequent atelectasis, are easily visualized Minor stenotic lesions are difficult or impossible to visualize, though their presence can often be inferred Lesions in the upper lobe bronchi usually cannot be visualized The temptation to demonstrate suspected lesions "around the corner" with opaque oil should be resisted This method supplies a great deal of information but only at the cost of masking the future course of the disease by the continued presence of the opaque solution.

The bronchoscopist's function goes considerably beyond merely reporting what he can see through his instrument. He must decide what is normal and what is not This is no easy matter It is not at all safe to assume that absence of visible changes is equivalent to negative findings Clear proof to the contrary will be adduced shortly There is no doubt, however, that when even minor gross changes are observed, tracheobronchial disease is present It is also axiomatic that the more pronounced the structural changes, the more severe the disease process is likely to be

What eventually happens to every bronchoscopist is that as his experience increases, he sets up his own criteria of normal and abnormal findings Jackson and Jackson,[32] for instance, stress the importance of color changes, but a reddened mucosa, as Houghton and Joules[26] point out, may be caused by coughing induced by instrumentation, as well as by pathologic changes

If the altered coloration is due to trauma, it will disappear promptly if manipulations are discontinued for a few minutes Congestion caused by coughing is more likely to be persistent. In at least one case in this series, which was finally classified as normal, the bronchoscopist noted that the unusual degree of congestion had almost led him to report tracheobronchial disease His judgment that the congestion was transient was borne out by the patient's smooth recovery after lobectomy and thoracoplasty

The comparison of series of cases would be easier and of more value if all observations were recorded according to the simple classification set up in Houghton and Joules'[26] analysis of the material studied by the British Tuberculosis Association Bronchoscopists in the six cooperating hospitals were asked merely to report *1* redness (easy bleeding), *2* gross mucosal changes (edema, granulations and active or healed ulceration), *3* distortion or stenosis Even with this almost elementary scheme, the positive bronchoscopies ranged from 18 7 per cent of 91 cases in one hospital to 85 3 per cent of 34 cases in another There was no apparent explanation for the wide spread except, as the authors observed, the difficulty of establishing a base line of normality

Correlation of Gross and Microscopic Observations No attempt was made in the study at Charity Hospital to determine the correctness of bronchoscopic observations in relation to laboratory and postmortem studies, but reports from the literature indicate that in this respect bronchoscopy is not yet a precise method and probably never will be

When Wilber[21] in 1942 reported 177 cases of tracheobronchial involvement in 500 autopsies on tuberculous subjects, bronchoscopy was still being used only occasionally It was performed in only 39 cases in her series, once in 35 cases and apparently twice in four others, with the following results Nine cases positive for tracheobronchial disease on bronchoscopy were negative at autopsy Eleven cases positive at autopsy had been reported negative on bronchoscopy Nine cases were positive on both autopsy and bronchoscopy, and 11 others were negative on both examinations Since autopsy was as always, the court of last resort, this meant an error of approximately 50 per cent in the bronchoscopic diagnosis.

Houghton and Joules'[24] study for the British Tuberculosis Association included a bacteriologic and microscopic study of 95 resected specimens, 57 secured at pneumonectomy and 38 at lobectomy In the pre-surgical bronchoscopic examination special attention was paid to the portion of the bronchial tree in which the resection was to be done, the findings being recorded merely as normal or abnormal The results of the study were as follows

In 56 cases reported as normal on bronchoscopy, there was histologic evidence of tracheobronchial disease in 53 resected specimens — 94 6 per cent. In 20 instances the disease was severe, and in 12 florid. Bacteriologically, guinea pig inoculation was positive for tuberculosis in nine of 29 bronchoscopically normal cases.

In 39 cases reported as abnormal on bronchoscopy, there was histologic evidence of tracheobronchial disease in 37 — 95 per cent In 14 instances the disease was severe, and in 18 florid Six of 23 guinea pig inoculations were positive.

As these observations indicate, bronchoscopic findings that are apparently normal, by no means exclude bronchial involvement, and vice versa, but the diagnostic error is much more likely to be negative than positive A negative error, it is scarcely necessary to add, is more misleading and may be much more harmful than a positive error

The histologic incidence of tracheobronchial disease is now being altered by the use of streptomycin therapy, a fact which should be borne in mind when both clinical and laboratory studies are made Thus Olson and his associates[25] reported that tracheobronchial disease was present in only 99 (31 7 per cent) of 311 specimens removed from patients who had streptomycin-PAS therapy for four months or more, while 144 specimens (49 4 per cent) of 291 removed from patients who had lesser amounts of treatment were positive for disease in this area

Differential Diagnosis In the absence of proof to the contrary it is reasonable to assume that tracheobronchial lesions in a patient with pulmonary tuberculosis are tuberculous lesions This was not always the opinion, and certain other conditions, naturally, must still be considered in the differential diagnosis

Syphilis is considerably less important now than it was 20 years ago Carcinoma of the lung, because of its greatly increased general frequency, is considerably more important. It was present in one (fatal) case in this series, in which the pneumonectomy performed was on the indication of bronchogenic carcinoma and not tuberculosis Boyce,[33] in his studies on fatalities from carcinoma of the lung at Charity Hospital of Louisiana at New Orleans, has called attention to the disastrous consequences which may follow concentration upon pulmonary tuberculous disease to the exclusion of possible malignant disease

The association of carcinoma of the lung and pulmonary tuberculosis is estimated at about 1 per cent, and the association of all carcinomas and pulmonary tuberculosis at about 3 per cent One other patient in this series had a fatal nasopharyngeal carcinoma, with extensive metastases, and another, who was living when last heard from, had a carcinoma of the breast. The incidence of associated malignancy in this series is, therefore, not too far out of line with the general estimates

It might be added that two of the three diabetics in these 200 cases were in the bronchoscopically positive group Both died There were also two alcoholics in the series Both of these conditions greatly increase the difficulty of treating pulmonary tuberculosis and its complications

COLLAPSE THERAPY IN TRACHEOBRONCHIAL DISEASE

One fact which became evident when tracheobronchial disease first began to be understood has become increasingly evident as the use of bronchoscopy has increased it is that many failures of collapse therapy which were formerly regarded as inevitable and unavoidable are actually due to the existence of this complication As Eloesser[7] noted in 1934, and as many reported cases, including some in this series, are still proving, many patients with tracheobronchial disease can be treated by collapse therapy without harmful results. The risk is always present, however It is never clear in advance in which cases the results may be good and in which disastrous

The blind use of collapse therapy, whether nonsurgical or surgical, is, therefore, not justified When it is employed in the face of tracheobronchial disease, the post-therapy course is frequently stormy Collapsed lungs often remain unexpandible The primary disease often spreads to the previously intact contralateral lung It is true that the introduction of potent antibiotics has greatly reduced the incidence and lethality of such complications as empyema, but that is no justification for the violation of sound surgical principles

The risk of collapse therapy in tracheobronchial disease can be explained on an entirely mechanical basis in all cases, though in the individual case the anatomic alterations and subsequent pathologic changes are modified by the acuteness and extent of the tracheobronchial involvement, and by the degree of stenosis already present and further induced by the collapse procedures employed All collapse procedures produce relaxation and shortening of the bronchi, with more or less angulation. All of them, therefore, produce some degree of obstruction if it is not already preesnt, increase whatever stenosis may already exist, and encourage stagnation of secretions

It is generally agreed that pneumothorax is the worst offender in this respect and thoracoplasty the least Keers,[34] perhaps, had this in mind when he said, in his 1953 presidential address to the Tuberculosis Society of Scotland, "that in the whole history of medicine there was probably no procedure which, since its introduction, had been so often misapplied and had been attended with so many serious, long-term complications"

If pneumothorax has been carried out in the presence of tracheobronchial disease of any consequence, distal angulation of the bronchial tree occurs on the affected side The so-called check-valve effect of a kinked bronchus often explains a cavity which continues to enlarge in spite of an apparently successful collapse If adhesions are severed after pneumothorax, the distortion of the bronchial tree is increased Bernstein[35] reported from a Veterans Administration hospital that pneumothorax was employed in 24 of 43 cases of tracheobronchial involvement and was unsuccessful in all 24

Both phrenic interruption and pneumoperitoneum act by lifting the dome of the diaphragm As a result, pressure is exerted against the bronchial tree from below If the elevation is excessive, dorsal angulation in the left main bronchus is greatly increased and its lumen, as well as the orifice of the upper lobe bronchus, may be reduced to a mere slit[27] The existence of an endobronchial lesion in these circumstances could well spell disaster On the right, although there is buckling of the main bronchus at the level of the orifice of the middle lobe bronchus, it is less significant[27]

Phrenic interruption has another deleterious consequence when it is used in the presence of tracheobronchial disease. Since it paralyzes the diaphragm, it further encourages the stagnation of bronchial secretions.

The wisest plan, when tracheobronchial disease exists, is to defer all collapse therapy until it is controlled If for any reason the internist considers it imperative to act at once, thoracoplasty does the least harm This operation is relatively safe if it is performed in the face of relatively mild involvement of the bronchial tree If, however, it is performed for disease of the right upper lobe, the distortion is extreme the superior angulation of the normal bronchus is brought down, so that it is sometimes possible to look directly down the right upper lobe bronchus and even to visualize some of the tertiary branches.[27]

CLINICAL AND ROENTGENOLOGIC VERSUS BRONCHOSCOPIC DIAGNOSIS.

Clinical Considerations A wheeze is generally regarded as the most important and most characteristic clinical observation in tracheobronchitis, but various observers have found other symptoms and signs important. In Acuña's[21] series, for instance, the patients complained, variously, of subjective pressure on the anterior chest wall, difficulty in raising sputum, rhonchi, an asthmatoid wheeze sometimes audible at a distance, snoring and a subjective sensation that a foreign body was caught in the trachea.

Physical findings included flatness on percussion of the interscapular area, subcrepitant rales, and circumscribed areas of atelectasis or emphysema. Heaf,[3] whose observations were limited to patients with tracheal disease, mentioned a loud distressing paroxysmal cough, very refractory to treatment, deep-seated retrosternal pain, a raw, aching sensation across the chest after a bout of coughing, a feeling of tightness across the chest, and limited sputum. The prominent pulmonary change at autopsy was fibrosis.

Our findings from the clinical standpoint, are much more in accord with that of Flance and Wheeler[17] Although they regarded their records as fairly accurate, their patients showed no marked wheezing, dyspnea, cyanosis or changes in the sputum beyond that which would be attributed to a terminal stage of the disease

In this series, the sputum was positive in 60 of the 66 cases of tracheobronchial disease, but otherwise the clinical picture was not characteristic. It was, in fact, chiefly the picture of basic tuberculosis, with fever, cough and hemoptysis the most prominent symptoms A wheeze was present in only 13 cases in the whole series, in seven of these there was no endobronchial involvement, while in only one was the disease stenotic in character For what it is worth, it might be said that there were three fatalities in these 13 cases

The important consideration is not the symptoms and signs which are or are not present in tracheobronchial tuberculosis It is the inability of even astute and experienced internists to make the diagnosis by clinical methods In the 121 bronchoscopically positive cases collected by the Research Committee of the British Tuberculosis Association[26] there was clinical evidence of disease in 48 (37 per cent), the incidence at the six cooperating hospitals ranging from 14 to 70 per cent, but there was also clinical evidence of the disease in 36 of 255 normal cases — 14 per cent. The interpretation of symptoms and signs varied widely and showed clearly that clinical assessment is not a reliable guide to diagnosis Jarman's[6] experience was to the same effect when a presumptive diagnosis of present or absent tracheobronchial disease was made on clinical grounds, it was 51 5 per cent correct in the bronchoscopically positive cases and 86 3 per cent correct in the negative cases

Roentgenologic Observations Roentgenologic observations are no more reliable in the identification of cases of tracheobronchial disease than are clinical observations As all workers in the field of pulmonary tuberculosis know, bronchial stenosis may occur without roentgenologic evidence of atelectasis, and complete roentgenologic stenosis may be observed in a patient who gives no clinical evidence of what has occurred On the other hand, Wilson's[31] statement is probably correct, that if careful X-ray observations are added to careful clinical observations in the selection of cases of pulmonary tuberculosis for bronchoscopy, the incidence of tracheobronchitis should be at least 50 per cent.

Most of the roentgenologic findings which may indicate tracheobronchial disease were present in the 200 bronchoscoped patients studied at Charity Hospital (see Fig 9) They were present, however, with much the same frequency in both bronchoscopically positive and bronchoscopically negative cases. Certainly there were no findings in either group which would warrant the diagnosis of tracheobronchial involvement or its exclusion on roentgenologic findings alone.

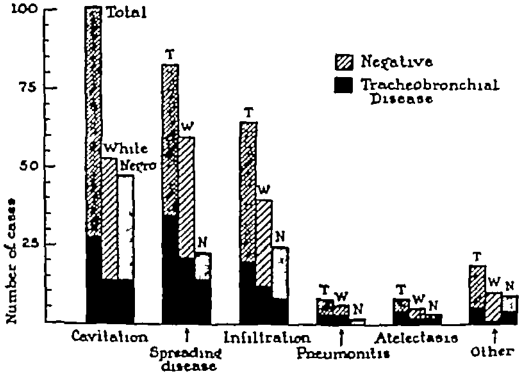

Fig 9 Roentgenologic observations in 200 bronchoscopically studied cases of pulmonary tuberculosis, Charity Hospital 1946 1953

Examination of Fig 9, in which the observations are overlapping, shows that cavitation was the most frequent roentgenologic finding It occurred in 48 of the 79 negroes, and in 53 of the 121 white subjects studied. Cavitation is a predominant characteristic of pulmonary tuberculosis in the negro

The literature emphasizes that cavities of certain types are likely to be present in tracheobronchial disease. The list includes those which increase in size with pneumothorax or which do not close when pneumothorax is otherwise successful, those which appear and disappear or which vary in size from time to time, those which show fluid levels, those which are large and round or which have thin walls, and those which are located in the hilum. The cavities observed in the roentgenograms in this series showed, *in toto*, most of these characteristics, but this was not differentially helpful The same findings were present in both bronchoscopically negative and bronchoscopically positive cases and their presence, therefore, was not a reliable index of the presence or absence of tracheobronchial disease

In stenotic disease, it might be added, fluoroscopy is frequently *helpful in the selection of the cases which should* be bronchoscoped The presence of areas of trapped air is a positive indication for bronchoscopic study, though the absence of such areas, again, is no indication that the disease is not present

INDICATIONS AND CONTRAINDICATIONS FOR BRONCHOSCOPY

In the light of what has already been said, there need be little discussion of the indications and contraindications for bronchoscopy in pulmonary tuberculosis There are two general indications

1 Bronchoscopy should always be performed in the presence of symptoms, physical signs or roentgenologic findings suggestive of the disease These include a unilateral wheeze, positive sputum inconsistent with clinical and roentgenologic evidence of improvement, marked variations in the volume and character of the sputum, alternating positive and negative sputum, expectoration of fibrin plugs or mucus casts, which are suggestive of ulcerative disease,[31] persistently positive cultures from gastric washings without evident roentgenologic explanation, spreading disease, dyspnea out of proportion to the reduction in the vital capacity, fever, including persistent fever after thoracoplasty, atelectatic and obstructive pneumonitis, a sudden increase in the X-ray shadows about a previously stable focus[24]

2 Bronchoscopy should also be performed, as a precautionary measure, before any collapse therapy or resectional procedure The damage that may be done if collapse therapy is instituted in a patient with tracheobronchial disease more than justifies the time and effort required to perform bronchoscopy This precaution is doubly important if the disease is bilateral and bilateral collapse therapy is to be instituted

In the opinion of most observers, there are only three contraindications to bronchoscopy

1 It should not be performed in the course of profuse hemoptysis unless bronchoscopic aspiration of blood should be indicated The reason for this contraindication is not any possible ill effect from bronchoscopy during hemorrage, but the futility of performing a procedure which requires full vision when the field is hopelessly obscured by blood. Attempts at hemostasis by bronchoscopy are no longer regarded as of any value.

2 It should not be performed in ulcerative laryngitis, unless it is required for emergency reasons, such as sudden bronchial obstruction, because of the risk of disseminating the disease. If the laryngeal involvement is non-ulcerative, a properly performed bronchoscopy will do no harm.

3 It should not be performed in a patient so ill that he cannot tolerate the procedure at the time. Nor, for humanitarian reasons, should it be performed in a patient so near death that the information secured from the examination could not possibly benefit him. More is said on this subject under the heading of possible reactions.

TECHNICAL CONSIDERATIONS.

Except for certain precautions required by the infectious nature of the disease, bronchoscopy in tuberculosis is performed by exactly the same technique as in any other circumstances.

Anesthesia should be complete, to permit an adequate examination of the bronchial tree, but it should not be in excess of the requirements. The 200 bronchoscopic examinations studied at the Charity Hospital were performed under a combination of barbiturate premedication and topical anesthesia secured with either pontocaine or cocaine No drug reactions were noted. Ether was occasionally used, especially in younger patients.

Daly and his associates,[24] whose 434 bronchoscopies were all performed in young children stated that they had no difficulties in any of their cases, they used a combination of surital and local procaine. For both physical and psychic reasons young children should be completely anesthetized

The procedure could not yield information of value if it were performed on a struggling, frightened child, and no child should be subjected to such an ordeal

Although the great majority of the bronchoscopies performed in this series were done by residents, of course under supervision and after training, only four were listed as difficult.

All manipulations should be gentle No attempt should be made to force the bronchoscope past an actively obstructive lesion, particularly when it is undergoing superficial necrosis, the material dislodged would almost certainly contain tubercle bacilli, and spread of the disease to a healthy part of the lung would be almost inevitable Great care should also be used in the examination of ulcerative lesions, which are easily traumatized The instrument should always be withdrawn slowly and deliberately In obstructive cases the 5-mm bronchoscope is preferable to the instrument 7 mm in diameter

Jackson and Jackson[32] lay great stress upon the consistent use of draperies of the same shade of green Most observers prefer to conduct the operation in a completely darkened room, in which the color of the draperies would be of no consequence.

It would be utterly unrealistic to ignore the fact that inexperienced bronchoscopists, because they fear infection, are often less successful than they might be in the identification of tracheobronchial disease. Their apprehension manifests itself in two ways they are inclined to stand too far away from the patient, although a satisfactory bronchoscopic examination naturally requires inspection from very close at hand Much more often, they seem to work on the principle of getting in and getting out as fast as possible An examination conducted on this basis is also unsatisfactory Bronchoscopy must be a deliberate procedure.

This candidate has found that the beginner will promptly correct his ways if it is pointed out to him that the risk in tuberculosis is not from patients who are known to have the disease, and in whose examination the proper precautions wi be taken, but from patients who are not known to have it. known risk, in short, is seldom a risk of any consequence

The bronchoscopist, however, must never relax his precautions against infection This is a careless error which the more experienced operators are likely to commit. A strict aseptic routine must be followed Most hospitals provide some sort of protection in the form of a mask, like a welder's mask, and it should always be used. A double mask of heavy gauze should also be worn over both the mouth and the nose

The collection and examination of secretions may furnish useful information, particularly in cases in which the disease is suspected but the clinical picture is inconclusive and the sputum is negative. It is unfortunate that these studies are not made more often Tubercle bacilli were identified in the only case in this series in which they were employed.

Bronchoscopic biopsy was fairly common when tracheobronchial disease was first coming into prominence. It was generally discontinued because of the risk of invasion of normal tissue, spread of infection, and delayed healing of the incision, which far out-weighed the possible information to be gained by it. These objections are of less consequence since the introduction of the antibiotics, and biopsy is again beginning to be used in carefully selected cases. Its rationale is evident when the high percentage of histologic disease not diagnosed grossly is recollected Biopsy was used in only two cases in this series, and rather half-heartedly in them.

Serial Bronchoscopy Serial bronchoscopy has a double field of usefulness. If the original observation is negative but there is a strong suspicion that tracheobronchial disease exists, the wisest plan is to withhold definitive treatment for several weeks and then repeat the bronchoscopy Repeated observations yield a small but definite percentage of positive cases.

The second indication for serial examination, to follow the progress of an endobronchial or tracheobronchial lesion, was present in 22 cases in this series, in which 55 bronchoscopic examinations were made. Resectional therapy was eventually carried out in 17 cases The majority of the patients were bronchoscoped only twice, but one patient had five bronchoscopic examinations.

REACTIONS TO BRONCHOSCOPY.

One reason given by some internists for their failure to employ bronchoscopy in patients with pulmonary tuberculosis, no matter what information might be derived from it, is fear of spreading the disease Neither personal experience nor a review of the literature warrants this fear. Radner,[36] who is almost alone in his experiences to the contrary, made a search of the American literature in 1943 and found only 11 cases in which a spread of the disease followed this procedure In view of the thousands of bronchoscopies which had been performed by that date, this does not seem an excessive number, even granting that in every instance the spread of the disease was a direct result of the bronchoscopy, which does not follow In the 200 cases studied in this series, there was no instance of a sudden rise of temperature, hemoptysis, unexpected clinical or roentgenologic evidence of spread, or any other indication that the procedure had been harmful

Alexander,[37] whose voice will always carry authority, found the reaction of the tuberculous subject no different from that of the nontuberculous subject, and thought the worst possible sequela was a sore throat for a day or two, if that. McIndoe and his associates[16] reported that 45 of their 272 patients had transient changes in the larynx and 49 had mild febrile reactions, none of any significance Four patients had an increase in pulmonary disease, but these observers did not think that it was necessarily the result of bronchoscopy

Houghton and Joules[26] analyzed their 251 cases from the standpoint of possible reactions, finding no roentgenologic evidence of spread in any case, and a transient rise of temperature (above 99°F for three days) in only three cases — 1 2 per cent.

Coates[38] in 1948 reported on 473 bronchoscopies carried out on 233 patients at Trudeau Sanatorium over a 10-year period He found the increase in parenchymal disease in these cases in the two-month period after bronchoscopy to be no greater than in the preceding two-month period Atelectasis occurred in only one of the 73 cases in which an increase of the disease after bronchoscopy was noted His conclusion, that the skill of the operator plays a large part in the incidence of reactions, is perfectly sound. At Trudeau, of course, bronchoscopic skill is of a consistently high standard.

Radner,[34] as already mentioned, is alone in the high percentage of reactions reported after bronchoscopy. Fifty-three of 97 patients, who were examined 73 times at the Leahi Hospital in Honolulu, presented no deviation, clinically or otherwise, from the expected course. The other 44 patients who were bronchoscoped 110 times, showed more or less significant deviations. Eighteen had transient immediate rises of temperature, which were regarded as of no consequence, but 26 had secondary rises, all between the tenth and sixteenth days, and all lasting from 14 to 21 days. In 21 of the 44 cases, roentgenograms showed a minimal infiltrative spread, and in five cases there was atelectasis of a part of a lobe or an entire lobe.

Whatever may be the explanation of these unusual observations, the precautions which Radner recommends could profitably be followed. One is that bronchoscopy be performed at least three weeks before any contemplated surgery and that a repeat film be made just before operation. This will make it possible to distinguish between spread of the disease resulting from bronchoscopy and spread resulting from surgery. Another precaution is that six to eight weeks be permitted to lapse between bronchoscopic examinations, to avoid possible overlapping reactions. Radner is correct in his emphasis upon the importance of the prompt return of the cough reflex after bronchoscopy, though this candidate does not share his opinion that positioning is helpful.

That most observers consider a correctly performed bronchoscopy to be associated with only minimal risk does not, of course, mean that accidents do not happen. One of Acuña's[11] patients, *for instance, died of (proved) morphine* poisoning. Another of his patients, with bilateral disease of the fibrostenotic type, became extremely dyspneic during the procedure and required oxygen. Two of Hawkins'[18] 516 patients, both chronic asthmatics, developed cardiac depression, but both recovered promptly.

Three of Hawkins' patients died within three weeks of bronchoscopy. Two patients in this series died within a week. None of these five deaths could be directly related to the bronchoscopic examination, but there was no justification in any of the cases for employing the procedure These patients were obviously close to death When bronchoscopy can provide no information which would be useful in the management of the patient, as it obviously could not in these cases, it should not be performed Its employment to secure information of purely academic interest is totally unjustified and is not in line with humane medical practice

THERAPY

An analysis of therapy is scarcely the business of a bronchoscopist He will, however, fulfill his function with more interest and efficiency if he understands the indications for the various types of procedure and if he can follow up the results The data on the prebronchoscopic and definite management of these 200 cases are presented in the light of that philosophy

Before bronchoscopy, active surgery in these cases was chiefly in the form of collapse (see Fig 10) Forty-three of the 66 patients with endobronchial disease were treated by surgical collapse, and 42 (there is considerable overlapping because therapy was often multiple) were treated by nonsurgical collapse

Raffery[39] has pointed out that parenchymal disease and endobronchial disease present two separate therapeutic problems The manner in which the parenchymal disease is managed, he says, probably has little effect on the bronchial disease, but the bronchial disease may so complicate therapy directed to the parenchymal disease that it may have a profound effect not only on the parenchymal lesion but on the patient as a whole One of the ways to prevent such complications is to identify existing bronchial disease before therapy is undertaken It seems fair to say that 46 of the 66 patients in this group were put into unnecessary jeopardy by the performance of collapse therapy before bronchoscopic investigation of the status of the tracheobronchial tree

Definitive Therapy In some of the recent literature there has been a good deal of emphasis on the so-called target point of therapeutic result, which is the ideal to be reached before any surgery is undertaken in pulmonary tuberculosis The objectives include sputum conversion, roentgenologic improvement or a stationary status, and cavity closure This candidate has been told that at the 1954 meeting of the American Trudeau Society, Samson suggested that a healthy bronchial tree be added to these objectives This is a sound suggestion from an authority who deserves to be listened to with respect in anything connected with tuberculous tracheobronchitis

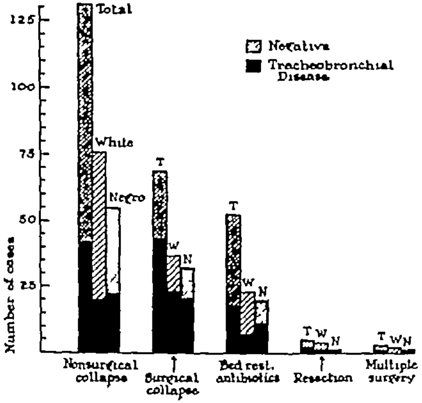

Fig 10 Pre bronchoscopic therapy in 200 cases of pulmonary tuberculosis, Charity Hospital 1946 1953

The ideals just described are not always reached in any variety of surgery Certainly they are not always reached in the surgery of tuberculosis They were not reached in many of the cases in this series Criticism, however, would not be justified In some cases there was undoubtedly a careless disregard of the existence of tuberculous tracheobronchial disease In some there was clearly a reliance on the ability of modern antibiotic therapy to prevent complications, a reliance that did not always prove justified The majority of the questionable or borderline cases, however, seemed to fall into the group of desperate risks described by Overholt and Wilson[12] in their first report on resectional therapy for these patients, who were steadily going down hill under more conservative measures, it was radical surgery or death

Collapse therapy, which is a tissue-sparing operation, is naturally to be preferred whenever it can be performed, but in the cases of endobronchial involvement in which repeated febrile attacks occur and the sputum continues positive, lobectomy and pneumonectomy, in spite of their risks, seem to have a definite if limited field These considerations must be borne in mind in examining the distribution of definitive therapy in the cases in this series (see Fig 11)

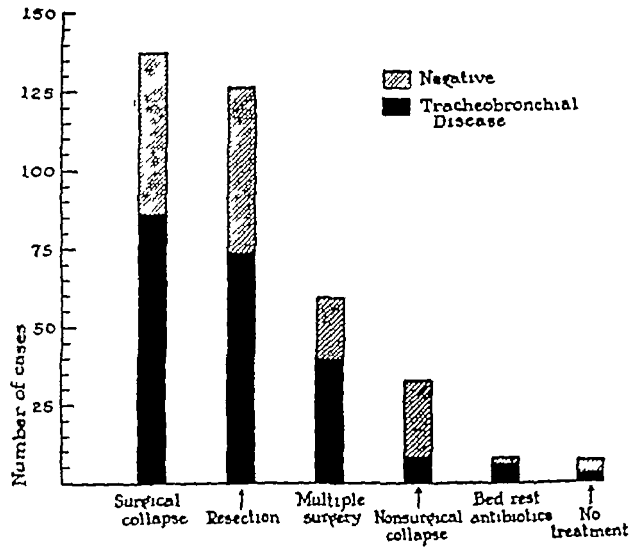

Fig 11 Definitive post-bronchoscopic therapy in 193 cases of pulmonary tuberculosis Charity Hospital 1946-1953

In 1945, when Overholt and Wilson[12] made their preliminary report on resectional surgery, penicillin was the *only* antibiotic available, and its use was then limited almost entirely to the military The field of all surgery has been expanded and made safer by the present general availability of this and other agents, including streptomycin, which is now part of the standard routine of therapy in pulmonary tuberculosis *All* patients at Charity Hospital in New Orleans, who are to be submitted to surgery are now treated from four to six months before operation, as well as afterward, with streptomycin by various routines and in combination with one or another of the newer antimicrobial agents

The availability of streptomycin and other potent antibiotics has not, however, altered any surgical principles, and their use does not compensate for failure to use all possible precautionary measures before surgery In other words, the fact that streptomycin is effective in tuberculosis does not justify the failure to search for endobronchial disease by bronchoscopy before surgery is undertaken. That this particular complication can be entirely eliminated by this agent, in spite of its effectiveness, is doubtful, furthermore and paradoxically, streptomycin can produce the very complication that it sometimes prevents Healing with stenotic scarring is now a proved possibility in streptomycin-treated cases of tracheobronchitis As Judd[40] warns, forgetfulness of this possibility might mean overlooking impending bronchial strangulation, which could be fatal There seems no reason to take for granted that this catastrophe might not happen in the patient with tracheobronchial disease before it has been controlled

End Results The five deaths in the group of patients without tracheobronchial disease and the six in the group with tracheobronchial disease need no special discussion Two patients died within a week, before any therapy could be instituted, as already mentioned, they should not have been bronchoscoped There were two immediate post-operative deaths not related to the presence or absence of tracheobronchial disease. One patient died of carcinoma of the lung, one of nasopharyngeal carcinoma, and one of massive hemorrhage from tuberculosis of the bladder The majority of these deaths were without relation to tracheobronchial disease and can be eliminated from the discussion. It might be added, however, that in Houghton and Joules'[26] study the mortality was higher for resection in patients with tracheobronchial disease than in those without this complication

In this series there was only one surgical complication, a bronchopleural fistula, in the 115 patients without tracheobronchial disease who were treated by surgery In the 55 patients with tracheobronchial disease who were similarly treated there were five instances of bronchopleural fistula, one of empyema, and three of contralateral spread In Houghton and Joules'[26] study of resections in two English hospitals, all the complications were concentrated in the histologically positive cases There were four instances of fistula or empyema in 31 patients with moderate disease, eight in 34 with severe disease, and nine in 25 with florid disease As they point out, the record may not be statistically significant, but it is not one that should be ignored from the clinical standpoint

No attempt was made in this series to follow up the 189 patients who survived surgery or other therapy Results of a sort, however, are available, for periods varying from three months to nine years, in 173 patients, and they are presented for what they are worth To make the comparison between cases with and without tracheobronchitis it would be necessary to match case with case in all details This is obviously impossible, but the crude follow-up (see Table 2) nonetheless has features of significance

The end-results that are available leave no doubt of the greater seriousness of pulmonary tuberculosis complicated by tracheobronchial disease. There were no unimproved patients, for instance, in the 113 without demonstrable disease of the bronchial tree, but one-fourth of the 60 patients with tracheobronchial disease showed no improvement over periods of observation varying from three months to two years after treatment Eighty-three of the 113 patients (73 5 per cent) without tracheobronchial disease were classified as having arrested disease, against 26 of 60 (43 3 per cent) in the group with tracheobronchial disease Like the results in Houghton and Joules'[26] series, these data may be of minor statistical significance, but they are of major clinical importance

THE FUNCTION OF THE BRONCHOSCOPIST IN PULMONARY TUBERCULOSIS

Phelps[41] in 1936 wrote with a good deal of indignation that medical men did not appreciate the importance of such complications of pulmonary tuberculosis as obstructive em-

TABLE 2—FOLLOW UP TO DATE IN 173 TUBERCULOUS SUBJECTS AFTER BRONCHOSCOPY AND DEFINITIVE THERAPY CHARITY HOSPITAL, 1946-1953

Duration Observation	Unimproved		Improved		Arrested		All Cases	
	Positive*	Negative**	Positive	Negative	Positive	Negative	Positive	Negative
To 6 months	6		4	23			10	23
1 year	8		5	3	10	14	23	17
2 years	1		6	1	4	19	11	20
3 years			2	1	6	19	8	20
4 years			2	2		12	2	14
5 years					4	4	4	4
6 years					1	11	1	11
7 years						3		3
8 years					1		1	
9 years						1		1
Total cases	15		19	30	26	83	60	113

Tracheobronchial disease diagnosed by bronchoscopy

** Tracheobronchial tree negative by bronchoscopy physema, obstructive atelectasis and "drowned lung," and should have it constantly impressed upon them In view of the information that could be obtained by bronchoscopy, he felt that no tuberculosis sanatorium could be said to be completely staffed without a bronchoscopist

Whether a full-time bronchoscopist should be attached to such a tuberculous section as is operated at Charity Hospital in New Orleans is doubtful He probably could not be kept fully occupied The wiser solution seems to be to make the services of bronchoscopists attached to the general staff fully available to this unit

The position of a bronchoscopist in a general hospital is somewhat different from that of a staff member in a tuberculosis sanatorium In many senses it is a delicate one. He is a consultant He enters a case only upon consultation and re-enters it upon the same invitation He does not select the cases for bronchoscopy except indirectly, by general advice and force of example He does not determine therapy, and is not usually asked to advise upon it He merely demonstrates, as best he can, the lesions of tracheobronchial disease and gives his interpretation of what he has seen

It is an easy matter, given these circumstances, to use the services of the bronchoscopist less often than they should be used Routine bronchoscopies, even in a tuberculosis sanatorium, are not indicated for a great many reasons, one of them being the entirely practical consideration that there are not enough bronchoscopists to perform them The same consideration holds in a general hospital On the other hand, as the situation at Charity Hospital shows (see Fig 1), the bronchoscopist might profitably be employed much more often in the management of pulmonary tuberculosis When only 200 bronchoscopies are performed in 7,500 admissions for tuberculosis, 1,000 of which were managed surgically, it is impossible to escape the impression that a great many opportunities for useful cooperation have been missed.

Failure of cooperation, it would seem, lies on both sides The concern of this candidate is naturally with the faults of the bronchoscopists In questioning medical men on the tuberculosis service, he found that one reason why they did not use bronchoscopists more often was that, while their consultations were eventually answered, there was usually a notable lack of promptness in the response, furthermore probing deeper, he found that the consultations were frequently not answered with the willingness and enthusiasm which would encourage further consultation. Surgeons in the tuberculosis unit made much the same complaints

These are, perhaps, not very sound reasons for not using bronchoscopy more often, they are, however, very practical ones One of the results of such a study as this is to bring out such errors and misunderstandings

Patients with tuberculosis would be better served if medical men and bronchoscopists cooperated more fully with each other Even more ideal would be a unit composed of internists surgeons and bronchoscopists, who studied the patient as a whole rather than piecemeal, as is too often the way at present. The bronchoscopist should and could have a very wide field of usefulness in pulmonary tuberculosis. He is needed for diagnosis Whether or not he is asked to advise about therapy, therapy must be based upon the observations he reports

The analysis of these 200 cases at Charity Hospital of Louisiana in New Orleans suggests that the bronchoscopist is not extending himself in his potential area of usefulness as he might, and as, indeed, he must if he is not to lose his status as a diagnostic endoscopist, and if patients with tuberculosis are to receive the full benefits of modern scientific therapy

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MACROPHAGES IN AURAL SECRETIONS AND THEIR CLINICAL SIGNIFICANCE *

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In 1953 Bryan[3] published a comprehensive investigation dealing with the cytology of aural secretions in connection with acute otitis media and mastoiditis The most interesting points in this article were the identification of large phagocytic cells in aural smears and, in particular, the observation that a certain correlation seemed to exist between the occurrence of these cells and the clinical course of otitis

On the basis of extensive material consisting of clinically followed cases of otitis media Bryan concluded that "*a* The large phagocytes are an indication of relatively severe acute otitis media and usually mastoiditis, *b* Absence of phagocytes in the discharge of acute otitis media indicates a relatively mild illness of short duration "

In the histopathological literature, which will be reviewed later in this article, the occurrence of macrophages in the exudates of otitis media has been mentioned earlier, but Bryan is the first to stress the possible diagnostic and prognostic significance of this finding Bryan's idea is of theoretical and practical importance, especially at present when the cytological examination of secretions is continually extending its scope also in the field of otorhinolaryngology

In this work we have attempted to study in particular the correlation between osteolytic processes and the occurrence of macrophages in aural secretions To obtain a wider basis for conclusions we have supplemented the clinico-cytological examinations with histo-pathological studies

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GENERAL CONSIDERATIONS

Metchnikoff, the founder of the theory of phagocytosis divided the phagocytic cells into two main categories the microphages or polymorphonuclear leukocytes of the blood, and the macrophages, which are large cells of varying genesis and morphology In this connection we are chiefly interested in the macrophages Terms that are used synonymously in the literature are for example polyblasts, clasmatocytes, histiocytes, large mononuclear cells, adventitial cells, pseudoxanthom cells, foam cells etc. As a brief summary of the descriptions presented in the textbooks of histology,[13] pathology,[1,4,7,10,11] and cytology[21] the following facts may be mentioned

The origin of macrophages is still an open question It seems that they arise chiefly from the monocytes of the blood, from the histiocytes of the tissues and from the different cell types of the reticulo-endothelial system in general All cells having mesenchymal properties may, however, assume phagocytic activity and become macrophages when needed (Möllendorff[15])

The morphological and structural characteristics of macrophages show great variations, depending upon their function and on the type of the irritant. A detailed description is superfluous in this connection

Under normal conditions macrophages are generally present in the tissues in very small numbers In some physiological secretions of the organism, for example in sputum and in vaginal secretion, they are a normal finding[21], otherwise they are found more abundantly only in connection with pathological processes under conditions in which there is abnormal destruction of tissues, and in which the general circumstances are favorable for them In inflammatory processes they form a part of the defense action and resorptive mechanism of the organism.

According to Menkin[14] the cytological picture of an exudate is dependent upon the changes in the hydrogen ion concentration in the tissues during the inflammatory process In his monograph dealing with the dynamics of inflammation he writes

The usual cellular sequence in the development of an acute inflammatory reaction consists of an initial infiltration of polymorphonuclear leukocytes which is subsequently replaced by an abundance of macrophages The underlying mechanism involved in this basic phenomenon depends on the production of a local acidosis in the inflamed area At a pH varying between 7 2 and 7 4 the predominating cell of an exudate is the polymorphonuclear leukocyte Between 7 0 and 6 8 the macrophage constitutes the chief cellular element Concomitant with the rise in hydrogen ion concentration, the polymorphonuclear leukocyte manifests various signs of degeneration, injury or necrosis Below a pH of 6 7 or thereabouts all types of cells are injured and a state of frank suppuration ensues

REVIEW OF THE OTOLOGICAL LITERATURE

In his article Bryan presented a detailed review of the cytological investigations of aural smears as well as of the reports of macrophages in aural tissues under normal conditions, therefore we confine our review to the investigations dealing with the occurrence of macrophages in the middle ear during inflammatory processes

Goerke[8] was probably the first who paid attention to these cells In his histopathological investigation he stated that, in addition to the usual cells found in pus, the inflammatory exudate of the middle ear contains large mononucleated cells and multinucleated phagocytic giant cells Manasse[12] spoke of "Korbzellen" and Doederlein[6] of "gedunsene Exsudatzellen," mentioning also the occurrence of multinucleated giant cells Singer,[20] however, seems to have been the first to identify these cells as macrophages and to present a detailed study concerned with their occurrence in the middle ear, their origin, and their morphological and structural characteristics, as well as their function According to his report, macrophages are an essential element in the inflammatory reaction of the subepithelial tissue in the middle ear

On the basis of animal experiments he stated that this reaction takes place very rapidly Macrophages, however, are most abundantly seen at the later stages of inflammation, when the process of healing begins It seems that they act chiefly as "scavengers" which phagocytose bacteria, cellular debris, and lipoid substances arising during destruction of cells, and carry them into the blood and lymph vessels, or into the middle ear cavity, from which they are removed with the aural discharge, furthermore, they probably play an important role in the process of immunization and in the defensive action of the organism in general

Their rapid appearance, in Singer's opinion, is due to the fact that the subepithelial tissue in the middle ear originates in the reticulum of the previous marrow spaces This tissue thus belongs to the reticulo-endothelial system Perhaps the absence of lymphoid structures in the mucous membrane of the middle ear is compensated in this way

Siirala[18] found macrophages in the endolymphatic sac and duct under normal conditions and Brunner[3], in cases of serous labyrinthitis Brunner concluded that exudate is carried away from the internal ear, at least to a great extent, by phagocytes In addition, he mentioned that macrophages are commonly seen in the exudate of acute otitis media

Ojala,[14] in an investigation dealing with the histopathology of adhesive otitis, also presented some observations regarding the occurrence of macrophages in connection with otitis media. He stated that "macrophages were fairly often encountered in the exudate in cases of acute otitis in which the most active stages of exudation was apparently over"

Macrophages were also a very common finding in old epithelium lined pseudocysts formed in the middle ear as a result of previous inflammations In these cases there were few if any signs of active inflammation in the surrounding subepithelial tissue It seemed that macrophages had the function of removing disintegration products from these cysts, the drainage of which was otherwise not possible

AUTHORS' MATERIAL

The clinico-cytological material consists of 107 cases of otitis media, 102 acute and five chronic, treated in 1954 in the wards or the out-patient department of the Otolaryngological Clinic, University of Turku. Because the main purpose of our study was to obtain information regarding the correlation between osteolytic processes and the occurrence of macrophages in the aural discharge, the series was selected to contain chiefly cases of acute otitis media which had a prolonged course, or which seemed to be severe from the beginning

A small number (17 cases) of clinically mild cases of otitis were included for comparison The majority of the patients were children, six months to ten years of age (59 cases) All patients with purulent acute otitis were treated with antibiotics after the bacterial strain and its resistance had been determined The patients were kept under observation until the otitis was definitely healed A simple mastoidectomy was performed in ten cases of acute, and a radical operation in three cases of chronic otitis

Smears were made from the aural secretion, usually by means of puncture and aspiration of the tympanic cavity, at intervals of five to seven days, sometimes more frequently, until the inflammation healed The smears were dried in air and stained by May-Gruenwald-Giemsa's methods Supravital staining was not used

A histological study of bone pieces obtained at operation was made in seven cases of simple mastoidectomy and in the three cases of radical operation mentioned above

For additional information on the correlation between osteolytic processes and the occurrence of macrophages we reexamined the material used by one of us (Ojala) in an investigation of adhesive otitis This series comprises 116 serially sectioned temporal bones, 35 of which showed inflammation of the middle ear suitable for the purposes of our study

In addition, we made histological studies of bone pieces obtained at 32 mastoidectomies or radical operations performed earlier without a preoperative cytological examination of the aural discharge We also studied numerous smears taken from the bronchial secretion (26 cases) and from pleural and peritoneal exudate (60 cases) in cases of various diseases The purpose of this study was to compare the structural and morphological characteristics of the macrophages found in these cases, in which osteolytic processes were not possible, with those found in the middle ear Moreover some smears taken from exudates of purulent maxillary sinusitis (five cases) were examined

RESULTS

1 *Clinico-cytological Studies* In differentiating the cellular elements in the smears, attention was paid chiefly to the

macrophages, but other types of inflammatory cells were also recorded The proportion of macrophages was estimated roughly If a few isolated macrophages were revealed only on very careful search, the case was placed in the group designated in the following tables as "a few" The group "moderate" consists of cases in which some macrophages were found in almost all microscopic fields Cases showing numerous macrophages in all microscopic fields were placed in the group "abundant."

An attempt was made at first to determine how soon macrophages appear in the exudate after the onset of otitis For this purpose the material was grouped according to the clinical duration of the otitis at the time of taking the first smear (see Table I)

TABLE I.

THE PRESENCE OF MACROPHAGES IN THE FIRST SMEAR AND DURATION OF OTITIS AT THE TIME.

Number of Macrophages	Duration of Clinical Symptoms of Otitis				
	< 2 Days	*4 Days*	*5 7 Days*	*> 7 Days*	*Together*
None	14	17	2	3	36
A few		17	8	7	32
Moderate		8	6	10	24
Abundant			3	7	10
Total	14	42	19	27	102

The data regarding the duration of the clinical symptoms of otitis before the first smear were estimated on the basis of the case histories, and of course they are not always accurate. It may be said that the duration of the inflammation probably was not shorter, but especially in the cases of children, may sometimes have been longer, than the time indicated in Table I

Table I shows that macrophages were not found in cases in which the clinical symptoms of otitis had lasted less than two days The smears in these cases contained chiefly polymorphonuclear leukocytes In addition, red blood corpuscles, lymphocytes and monocytes were constantly found in various numbers, and often also fairly large mononuclear cells (c. #16—20 μ diameter) with a usually eccentric, rounded or ovoid nucleus and structureless cytoplasm without signs of phagocyted material

Apparently these cells were histiocytes which had not yet begun their phagocytic activity Although the material is small, and the data regarding the duration of otitis are not precise, it may be concluded that large phagocytes seldom make their appearance in the aural discharge during the first two days of otitis

The macrophages increased in number and size with the duration of the otitis When the symptoms of inflammation had lasted two to four days, macrophages were found in more than half the cases The five cases with a history of more than five days, but with no macrophages in the smears, were cases of clinically mild serous or mucous otitis and will be discussed later on On the other hand, macrophages were always found in cases of purulent otitis which had lasted more than five days when the first smear was taken Thus our findings suggest that macrophages are a constant cellular element in the exudate of the middle ear in connection with purulent otitis media of more than five days' duration

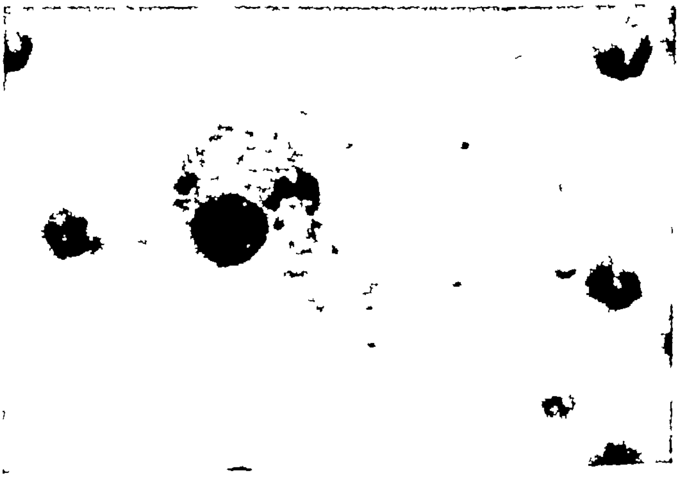

Fig 1 In this case the symptoms of an acute otitis media had lasted two days The smear showed a moderate number of small and medium sized macrophages about 20-30 μ in diameter the one seen in the micro photograph measuring 20 μ The ear healed within a week High power magnification

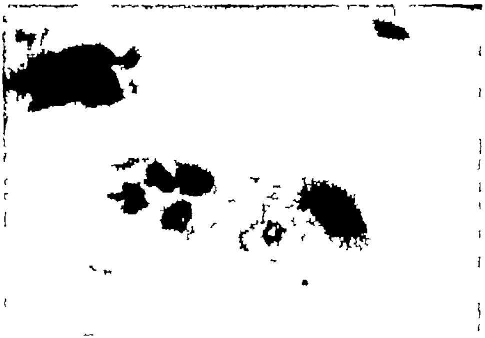

Fig. 2. The otitis had lasted 3 days before admission to the Clinic. The smears made every day revealed varying numbers of macrophages the size of which was at first fairly small but in the later smears also very large phagocytes were found This giant phagocyte the largest diameter of which is about 60 µ was found in a smear made 1 days after the onset of the otitis. Two days afterwards the ear was dry High power magnification

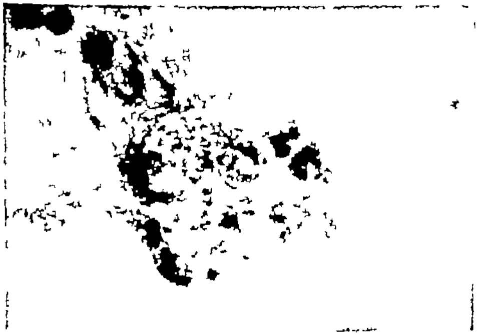

Fig 3 The otitis had lasted two weeks prior to the admission to the Clinic. Smears made at intervals of 3 to 4 days showed macrophages, the number and size of which varied during the subsequent course of the disease A simple mastoidectomy was performed one month after the onset of the otitis. The smear containing this large phagocyte (40 µ) was made immediately prior to the operation (cf also Fig 8) The smears after mastoidectomy showed macrophages in ever increasing numbers. After 8 days the ear was dry High power magnification.

The various morphological and structural characteristics of the macrophages are most clearly apparent in the photomicrographs (see Figs 1, 2, 3) , some clinical data are also given in the legends In the group in which otitis had lasted two to four days the macrophages were usually small, about 20-25 μ in diameter

Their cytoplasm contained vacuoles and/or particulate matter In some cases also larger macrophages, about 30-35 μ in diameter, were found scattered here and there in small numbers With increased duration of the otitis the larger macrophages become more common, but multinucleated giant cells were seldom seen in cases in which the otitis had lasted less than seven days before the smear was taken

Table II classifies the material by the clinical type of the otitis and by the presence of macrophages

TABLE II
MACROPHAGES IN VARIOUS TYPES OF OTITIS

Number of Macrophages	Type of Otitis			Together
	Serous	Mucous	Purulent	
None	6	1	29	36
A few	2	4	26	32
Moderate		2	22	24
Abundant	1	1	8	10
Total	9	8	85	102

The otitis was defined as serous, mucous or purulent, according to the otoscopic appearance of the tympanic membrane and the macroscopic and microscopic character of the exudate In all cases of otitis defined as serous or mucous, the culture revealed no growth of bacteria Table II shows that macrophages were found in nine of the 17 cases of serous or mucous otitis, in two cases they were abundantly present

The case history revealed that the otitis in these two cases had begun seven and 21 days earlier respectively, the initial symptoms, fever and pain, passed, and the patients later came to treatment because their hearing did not improve

It may be supposed, therefore, that the otitis had begun as a purulent one and was already in process of healing when the first smear was taken In all these cases the tympanic membrane was not perforated Clinical symptoms and signs of mastoiditis were absent and after myringotomy the ears healed in a short time without complications

In the seven cases of serous or mucous otitis with no macrophages in the exudate the symptoms were those of a secretory catarrh Five of them had lasted more than five days when the first smear was taken The exudate contained a few inflammatory cells, mainly lymphocytes and monocytes, or no cells at all The 29 cases of purulent otitis showing no macrophages in the exudate included 14 in which the otitis had lasted less than two days, and 15 in which it had lasted two to four days

Table III shows the correlation between the occurrence of macrophages and the clinical course of otitis in our case material

TABLE III.

THE PRESENCE OF MACROPHAGES PLOTTED WITH RECOVERY AND CLINICAL COURSE OF OTITIS

Number of Macrophages	Recovery within				From these with
	7 days	7 14 Days	14 30 Days	> 30 Days	Mastoidectomy
None	13	17	6		
A few	6	13	9	4	3
Moderate	1	12	5	6	5
Abundant		1	3	6	2
Total	20	43	23	16	10

The period of recovery shown in Table III was calculated on the basis of the case histories from the day of the onset of otitis to the day when the middle ear was dry the drum membrane of normal appearance, and the hearing within normal limits With respect to the proportion of macrophages, the cases were classified by the smear containing the largest number of macrophages The greater part of the patients were treated in the out patient department and checked at five to seven day intervals A resulting disadvantage was that the ears which made a rapid recovery were usually dry at the second examination, and further smears could not be taken

Table III shows that 30 out of the 36 ears without macrophages in the exudate made an uneventful recovery within two weeks This statement seems to support Bryan's view that absence of phagocytes in the discharge of acute otitis media indicates a relatively mild illness of short duration

According to case reports, there was a mild serous or mucous otitis in eight of these cases The remaining 22 cases showed all characteristics of a severe purulent otitis at the first examination The patients concerned came under treatment during th first few days of their illness Apparently macrophages had not yet appeared in the exudate in these early cases (see Table I)

When the patients came to the second examination the ear was already dry, and further smears could not be made The influence of antibiotics could not be precisely evaluated It seems, however, that our case material does not allow such generalized conclusions as presented by Bryan In our opinion, the only conclusion to be drawn from the absence of phagocytes in the discharge of acute purulent otitis media is that the otitis has lasted a rather short time

Of the 66 cases with macrophages in the exudate, exactly one-half recovered within 14 days In the other half the otitis was more prolonged, mastoidectomy being necessary in ten cases The proportion of cases lasting more than 14 days increased, in agreement with the finding of Bryan, with the number of macrophages in the exudate The proportion of mastoidectomies was approximately the same (about 20 per cent) in the groups showing a moderate or a large number of macrophages, it was about twice that in the group with a few macrophages Before drawing any conclusions we wish to deal shortly with some factors which do not appear from the table

It was stated in connection with Table I that the number of macrophages generally increased with the duration of otitis It must be added that in many cases macrophages were most abundant immediately before healing of the otitis We present two illustrative reports

Case 81, a boy eight years of age became ill two weeks previously with high fever and severe pain in both ears The family doctor prescribed aureomycin, 750 mg daily for one week and did not perform myringotomy The severe symptoms diminished but slight fever and earache persisted and the hearing was much impaired During the last two days before admission the fever rose again to 39° C The patient was sent to our out patient department and was admitted to the wards

The boy looked severely ill The temperature was 38 6° C The blood sedimentation rate was 78 mm an hour There was purulent maxillary sinusitis bilaterally The ear canals were dry the tympanic membranes were reddish thickened and bulged outwards Puncture and aspiration revealed much purulent exudate from which streptococcus pyogenes was cultured The Roentgenograms showed an extensive cell system diffusely shadowed but with no signs of destruction of bone In the smears macrophages were found in abundance.

The patient was treated with penicillin and streptomycin. The recovery was uneventful The profuse discharge from both ears ceased after three days After 10 days both drum membranes were of normal appearance and the hearing was normal

Comment In this case there was good reason to expect coalescent mastoiditis to develop According to Bryan, abundance of macrophages in the exudate should also suggest such a development. The Roentgenograms however, did not reveal signs of osteolytic processes This negative finding was supported by the prompt recovery after proper treatment. Although the part played by the antibiotics cannot be ignored, we are inclined to believe that reparative processes were already predominating, and only adequate drainage was needed for recovery

Case 11 a man 50 years of age. About three weeks previously the patient had a sore throat and soon afterwards experienced pain in the left ear A general practitioner performed myringotomy and prescribed penicillin There was a persistent slight discharge from the ear and the hearing was impaired Because the condition did not improve the patient was admitted to the Clinic

The general condition of the patient was good. The blood sedimentation rate was 22 mm an hour and the leukocyte count 8550 cu mm There was a slight mucous discharge from the left ear The Roentgenograms revealed an extensive cell system with diffuse shadowing but without signs of destruction of bone The smears contained neutrophilic and numerous eosinophilic leukocytes lymphocytes monocytes and a moderate number of macrophages Culture did not reveal growth of bacteria

The patient was treated with antibiotics and antihistamins for a week. There was no improvement on the contrary the hearing grew continuously worse and a simple mastoidectomy was performed about four weeks after the onset of otitis The extensive cell system was filled with sero-mucous exudate The mucous membrane was slightly edematous. There was no macroscopic evidence of destruction of bone Microscopic examination was not performed.

The recovery was prolonged After six weeks the ear was dry and the hearing almost normal The smears examined every week continued to show eosinophils and macrophages in addition to other inflammatory cells. Towards the end of the disease the number of eosinophils decreased and macrophages increased The last two smears contained only a few cells almost exclusively macrophages.

Comment In this case, the otitis apparently was in the main of allergic origin There was no evidence of osteolytic processes Macrophages, however, were found in the exudate during all phases of the disease, in even greater numbers after mastoidectomy Before the definitive healing the number of these cells increased, and at last the macrophage was the predominating cellular element in the smears

Let us now return to Table III Although the figures in the table seem to support the conclusion made by Bryan, i e that large macrophages are a prognostically unfavorable sign, such a conclusion apparently is somewhat beside the point. On the basis of our case material it seemed that the occurrence of large phagocytes in the exudate was a sign that the otitis had lasted a fairly long time rather than an indication of a prolonged course in the future

There was no evidence suggesting any correlation between the quantity of macrophages and osteolytic processes An abundance of macrophages in some cases seemed to suggest that the otitis was in the process of healing, furthermore, we could not find any type of macrophages characteristic of osteolytic processes The same structural and morphological varieties of macrophages were found both in cases with and without osteolytic processes

The five cases of chronic otitis in which a cytological study of aural discharge was made included three of cholesteatomatous otitis, one case of chronic otitis without cholesteatoma, and one case of simple mucosal suppuration with central perforation of the drum Macrophages were found in one of the cases of cholesteatomatous otitis and in the case of chronic otitis without cholesteatoma In the other cases of cholesteatomatous otitis the smears showed polymorphonuclear leukocytes, lymphocytes and an abundance of desquamated epithelial cells, which sometimes formed large syncytial masses According to Probst and Pfalz[17] such syncytial masses of epithelial cells are a characteristic finding in the discharge of cholesteatomatous otitis

2 *Histopathological Studies* The serially sectioned temporal bones at our disposal included 56 cases which showed signs of middle ear inflammation In 21 cases the exudate was serous and contained only some lymphocytes and monocytes or no cells whatever The remaining 35 cases were se-

lected for more detailed examination and were divided into three main groups on the basis of the inflammatory alterations

The first group comprised 12 cases of acute suppurative otitis media Unfortunately, the case histories did not reveal any information regarding the duration of the inflammatory process There was, however, some histological evidence that in seven of these cases the otitis was probably of rather short duration In the middle ear cavities there was purulent or seropurulent secretion without any signs of incipient organization

Haymann[9] has shown, on the basis of animal experiments, that organization of exudate in the middle ear may begin as early as during the first three to four days of inflammation So far as these statements apply to man, the inflammation in our cases may have lasted less than three to four days In three cases the tympanic membrane was in the process of being perforated In the others the tympanic membrane was to some extent infiltrated with inflammatory cells, but there were no necrotic areas suggesting perforation The exudate consisted chiefly of polymorphonuclear leukocytes A small number of lymphocytes and monocytes were also found but no macrophages These statements are in agreement with the results of our clinico-cytological studies

In the remaining five cases the inflammation seemed to be more prolonged The middle ear cavities contained numerous organization processes and purulent or seropurulent exudate Macrophages were abundant both in the exudate and in the organized tissue

The second group consisted of two cases of coalescent mastoiditis Fig 4 shows an area of intense osteoclastic resorption of bone in the mastoid air cells around the antrum The swollen mucous membrane is strongly infiltrated with polymorphonuclear leukocytes The cell cavities are filled with fibrinous purulent exudate containing chiefly polymorphonuclear leukocytes but no macrophages

On the other hand small macrophages (see Fig 5) are seen in some neighboring air cells, in which the exudate is in

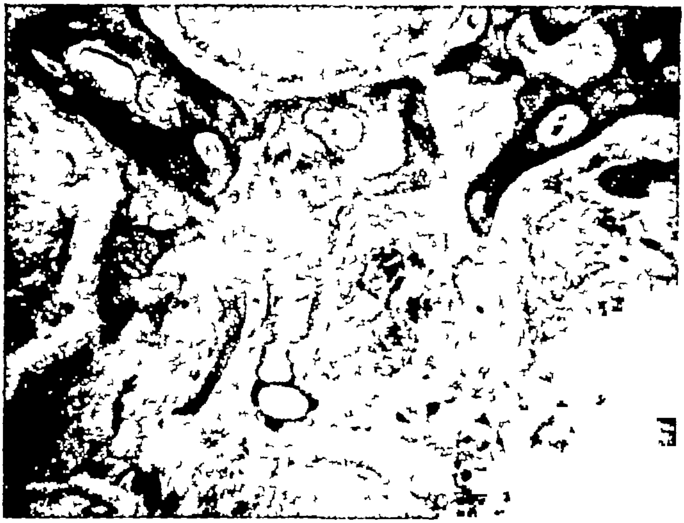

Fig 4 Mastoid air cells in a case of coalescent mastoiditis Macrophages were rarely if at all found in the areas of most intense osteoclastic resorption of bone Low power magnification

the process of organization and osteoclastic resorption of bone has changed into apposition of bone This seemed to be the general cellular sequence Macrophages were found very rarely, if at all, in areas where destruction of tissues was

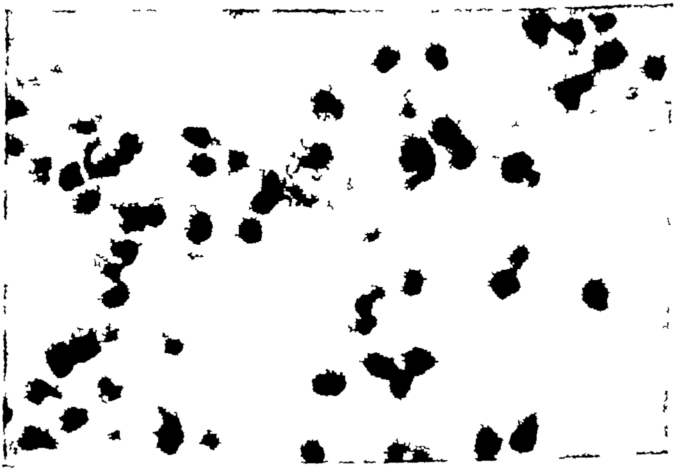

Fig 5 The same case as in Fig 4 Small sized macrophages in an air cell in which the inflammatory process seemed to be calming down High power magnification

predominant, with or without osteoclastic processes The more prominent the signs of reparative processes, the greater was the number of large macrophages both in the exudate and in the tissues

The third group contained 21 cases of different sequelae of otitis In addition to old adhesions, there were in 12 cases numerous organization processes in the tympanic cavity and in the mastoid air cells There was also serous or mucous secretion in varying amounts, and it contained numerous macrophages, in some cases only these cells Macrophages were also abundant in the organized tissue, in the subepithelial tissue, and in two cases in the neighboring marrow spaces (see Fig 6) The bony walls in these cases showed no signs of active osteoclasis, on the contrary, new bone was usually laid down

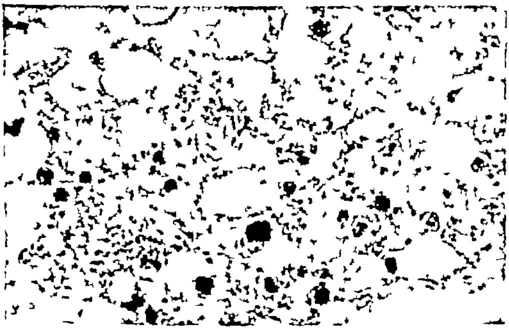

Fig 6 Multinucleated macrophages in a marrow bone. The neighboring air cells showed abundantly organized tissue and serous exudate containing exclusively macrophages. There was intense apposition of bone Medium magnification

In the remaining nine cases of this group the tympanic cavity and the mastoid air cells contained adhesive processes and numerous epithelium-lined pseudocysts which judging from the past histories, must have been formed years before. These cysts were usually filled with macrophages and

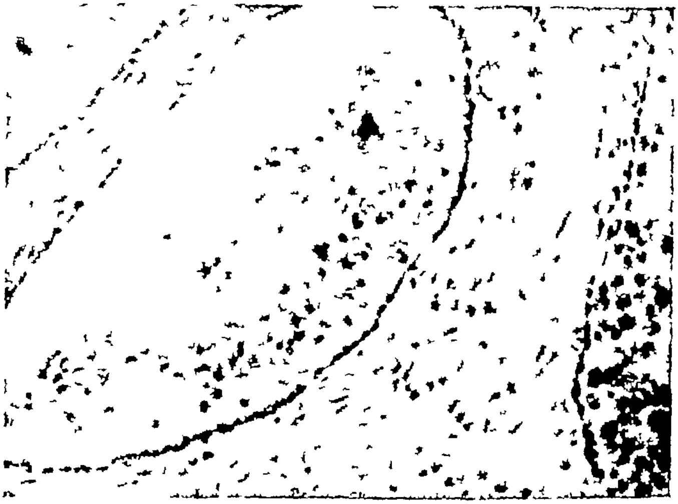

Fig 7 Old pseudocysts in tympanic cavity containing macrophages and desquamated epithelial cells The loose and oedematous subepithelial tissue did not show signs of active inflammation Medium magnification

desquamated epithelial cells (see Fig 7) In some cysts there were also droplets of homogeneous material It seemed possible that macrophages had the function of removing the disintegration products from these cysts

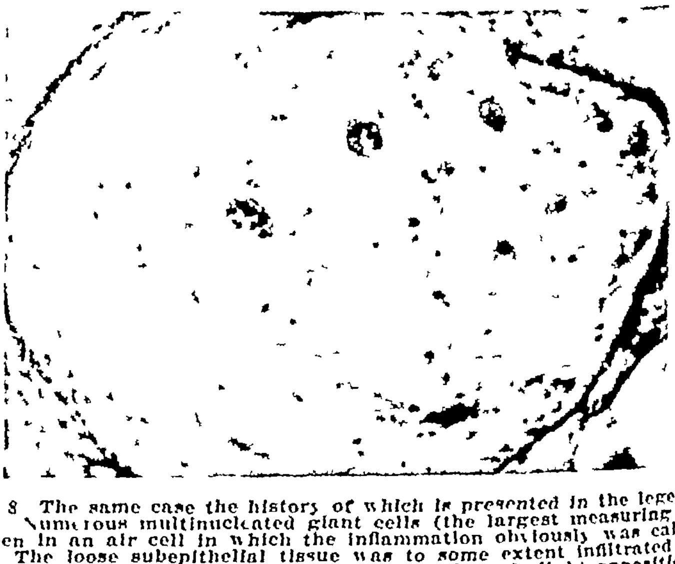

Fig 8 The same case the history of which is presented in the legend of Fig 3 Numerous multinucleated giant cells (the largest measuring $69\ \mu$) are seen in an air cell in which the inflammation obviously was calming down The loose subepithelial tissue was to some extent infiltrated with lymphocytes and plasmacells The bony walls showed slight apposition of bone Medium magnification

Histopathological study of bone pieces obtained by mastoidectomy and radical operation revealed findings which were in keeping with those reported above The series of mastoidectomy consisted of 16 cases of acute otitis, seven of these belonged to our clinico-cytological material Macrophages were most numerous in the air cells in which the inflammatory process was obviously calming down (see Fig 8) In the areas of active destruction of tissues macrophages were encountered rarely if at all

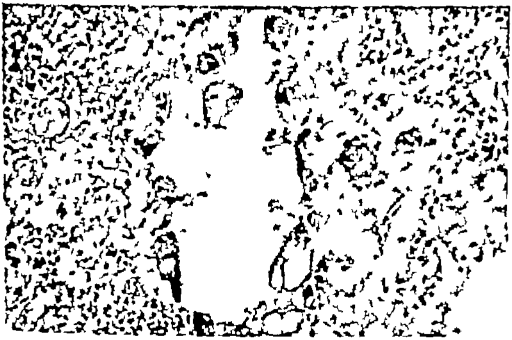

Fig 9 "Foreign body giant cells in granulation tissue in a case of chronic cholesteatomatous otitis. Medium magnification

The series of radical operation comprising 17 cases of cholesteatomatous otitis and six cases of chronic otitis without cholesteatoma, showed similar results It should be added that, besides other types of macrophages, large "foreign body" giant cells were a very common finding in these cases (see Fig 9) Usually they surrounded slits in the granulation tissue Evidently these slits had contained cholesterol or fatty acid crystals, which had resolved during preparation. The occurrence of such giant cells in connection with chronic otitis has been mentioned earlier, for example by Drennova[9], and Simonetta[10]

From these results it may be concluded that the occurrence of macrophages, in cases with and without osteolytic processes, is mainly linked up with the reparative and resorptive functions In coalescent mastoiditis reparative and destructive processes alternate, and there are always areas in which *either one or the other of these processes predominates* The macrophages occurring in the exudate of coalescent mastoiditis are obviously derived mainly from areas where reparative processes predominate There is no evidence for the assumption that an abundance of macrophages in the exudate of otitis media might be a sign of unfavorable prognosis In fact, our clinico-cytological and histopathological studies seem to indicate rather the reverse

Fig 10 Large multinucleated giant cell in bronchial secretion High power magnification

3 Other Cytological Studies Bronchial secretions were secured during a diagnostic bronchoscopy in 26 cases of specific or unspecific inflammation, or of suspected malignancy All the smears contained some, mostly numerous, small or medium sized macrophages, 15 to 25 μ, showing various amounts of phagocyted dust particles ("dust cells") Larger giant phagocytes, 25 to 75 μ, were seen with phagocyted cellular debris or particulate matter in 17 cases of long-standing pulmonary infection (see Fig 10) The appearance of these cells was indistinguishable from those encountered in aural smears

Pleural and peritoneal exudates were obtained by puncture and aspiration and stained, like the bronchial washings, by the Papanicolaou technique The 28 pleural exudates were mostly associated with infectious disease, the 22 peritoneal fluid specimens with a condition of cirrhotic liver or suspected malignancy In these smears lymphocytes and monocytes were frequently seen. Giant phagocytes were clearly more scarce than in bronchial aspirations Nevertheless typical large phagocytes with ingested cellular debris were found in six pleural and four peritoneal specimens

All of the five cases of purulent maxillary sinusitis, in which the exudate was studied cytologically, were complications of acute rhinitis and, judging from the clinical symptoms, had lasted about one or two weeks The smears contained chiefly polymorphonuclear leukocytes Macrophages were not found although they were very carefully sought.

DISCUSSION

Our studies showed that the usual cellular sequence in inflammations of the middle ear follows the general lines decribed by Menkin For the first few days of acute suppurative otitis the polymorphonuclear leukocyte is the chief cellular element in the exudate It seems that active macrophages seldom make their appearance in the exudate before the otitis has lasted about two days After about four days they seem to be a constant finding They increase in number and in size with the duration of otitis and, before healing of the inflammation they may become the predominating cellular element in the exudate

Unfortunately, we could not determine the pH of the exudate, the lowering of which, according to Menkin, is responsible for the changes in the type of inflammatory cells We can only confirm the statement made by Singer, that the occurrence of macrophages is intimately connected with the general defensive, reparative, and resorptive actions of the body and therefore, is dependent on the extent of inflammatory damage to the tissues In very mild catarrhal inflamma tions with little or no destruction of tissues macrophages are not found On the other hand, they are always found in the later stages of inflammation involving damage to the tissues whether or not there are any osteolytic processes

On the basis of our studies there are no types of macrophages specific to inflammations of the middle ear only, nor is there any type of macrophages specific to osteolytic processes As a matter of fact, the macrophages found in the exudate of a coalescent mastoiditis apparently are not derived from the areas of active osteoclasis but from those in which reparative processes predominate, therefore the quantity and the quality of the macrophages in the exudate of an otitis media obviously do not offer any reliable basis for conclusions regarding the presence of osteolytic processes or regarding the course of the otitis in the future

A great number of macrophages may be a sign of extensive damage to the tissues but, at the same time, it seems to indicate that the destructive process is already calming down A few or absent macrophages in a severe acute otitis may indicate that the inflammation has lasted a rather short time, or possibly that there is an acute exacerbation On the whole, the diagnostic and prognostic significance of macrophages seems to be fairly limited Perhaps it may be said that an ever-increasing number of macrophages in successive smears may be a prognostically favorable sign Variation in the number of macrophages may indicate repeated acute exacerbations being thus, perhaps, a sign of unfavorable prognosis

SUMMARY AND CONCLUSIONS

This study was stimulated by Bryan's interesting investigations regarding the diagnostic and prognostic significance of large phagocytes in the exudates of otitis media According to Bryan, large phagocytes indicate a relatively severe acute otitis media, usually with mastoiditis, while the absence of phagocytes indicates a relatively mild illness of short duration

The present paper is based on clinico-cytological and histopathological studies The series studied cytologically comprises 107 cases of clinically followed otitis media, furthermore, smears of bronchial secretions and pleural and peritoneal exudates were examined in 86 cases of various diseases The purpose of this latter study was to compare the structural and morphological characteristics of the macrophages found in these cases, in which osteolytic processes were not possible, with those found in the exudates of otitis media In addition cytological examination of the exudate was made in five cases of purulent maxillary sinusitis

The histopathological material consists of 35 serially sectioned temporal bones with various inflammations of the middle ear and of bone pieces obtained at 16 mastoidectomies and 23 radical operations

The results of the investigation allow the following conclusions

1 The cellular sequence in connection with inflammations of the middle ear does not differ from that described in connection with other inflammations in the organism After the first few days the macrophage is a constant cellular element in the exudate of purulent acute otitis media

2 There is no type of macrophage characteristic of inflammations of the middle ear only, and also no type characteristic of osteolytic processes The macrophages found in the exudate of coalescent mastoiditis are chiefly derived from the areas in which reparative processes predominate

3 The quantity and quality of macrophages in the exudate of an otitis media obviously do not offer any reliable basis for conclusions regarding the presence of osteolytic processes or regarding the course of the otitis in the future

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TRANS-INCUDAL STAPEDOLYSIS FOR STAPES MOBILIZATION IN OTOSCLEROTIC DEAFNESS*

(Under Audiometric Control)

A Surgical Technique for Improvement of Hearing in Otosclerosis Is Described Utilizing New Methods In the Stapes Approach.

Victor Goodhill, M D,

Los Angeles, Calif

SURGICAL PHYSIOLOGY OF TRANS-INCUDAL STAPEDOLYSIS TECHNIQUE

1 Methodical lysis of stapedial footplate ankylosis by either simple rocking or mechanized vibratory force, under *operative audiometric control*

2 Avoidance of incudo stapedial joint dislocation by use of trans-incudal force, force is not applied to the neck of the stapes, but to the capitulum through the lenticular process of the incus In very loose incudo-stapedial joints, preliminary immobilization of this joint is obtained by cementing with a plastic material

3 Avoidance of surgical crural fracture by preliminary stapediotenotomy to eliminate counter pull by stapedial tendon, *in cases where tendon is under tension*

4 Avoidance of unnecessary manipulation when microscopic examination and palpation reveal pathologic crural atrophy and footplate replacement by pathologic otosclerotic bone

HISTORY

That ' ankylosis" of the stapes footplate can produce a conductive type of deafness has been known for over a century Kessel,[1] in 1876 began the surgical saga of attempts at lysis of

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The term 'stapedolysis seems useful in that it expresses a procedure aimed at lysis or freeing of adhesions around the stapes This is the objective of the surgical procedure and the one word simplifies the description of the surgical objective

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the fixed stapedial footplate. He was followed by many otologists who sought surgical techniques to reopen the closed pathway of perilymphatic sound conduction to the basilar membrane. Many names should be mentioned in this connection. It is not within the scope of this paper to go into details of this rather fascinating chapter in medical history. Blake,[2] Jack,[3] Miot,[4] Holmgren[5] and many others were identified with attempts at recreation of an acoustically mobile perilymphatic pathway to the organ of Corti.

Most of the attempts of these early surgical investigators apparently resulted in failures, although some individual brilliant successes were reported sporadically towards the end of the last century. It is surprising that some of the favorable early reports were not followed up by long range studies, however, it should not be inferred that this lapse was necessarily due to bad results. Medical history is replete with examples of discontinuity in the flow of clinical knowledge.

Whatever the causes were, the surgical approach in otosclerosis was transferred to the vestibular labyrinth shortly after the turn of the century. Early failures in this new story of *fenestration surgery* were also discouraging. The researches of Holmgren,[5] the persistence of Sourdille[6] and the final brilliant technical achievements of Lempert[7] brought to surgery for the first time a practical method for restoration of hearing in otosclerosis by fenestration of the external semicircular canal, nevertheless, the possibility of direct approach to the ankylosed stapes continued to intrigue some otologists.

Rosen's[8] recent reports on stapes mobilization have been most encouraging, and have again turned the interests of otologists back to the stapedio-vestibular articulation.

Recent surgical experiences in this field have prompted me to suggest a technique which appears advantageous and which has yielded encouraging primary results in both ideal and fair candidates for surgical intervention in "otosclerosis."*

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* In this paper the term otosclerosis is used in the context of clinical otosclerosis, a term frequently encountered in fenestration literature. I conceive of this term as describing footplate ankylosis probably by a variety of pathologic states, one of which is the typical histologic otosclerosis as described by Wittmaack,[9] Guild,[10] Wolff,[11] Nager[12] and many others. Clinical evidence is accumulating which points to the probable existence of lesions other than the classic herde of histologic otosclerosis in the production of footplate ankylosis.

It is not within the province of this communication to deal with these results The periods of observation are too short to permit sober evaluation Such evaluation will be presented in a further paper, when sufficient time has elapsed for proper study of *long term* results The specific details in this technique are based upon preliminary studies of earlier failures and upon basic physiologic principles in labyrinthine and intra tympanic surgery

There is sufficient evidence at this time to indicate that present technical improvements in stapes surgery may possibly produce results which might have permanent value No such proof has yet been offered to the profession in any long range clinical case material, nevertheless, it is certain that many otologic surgeons wish to study this approach, and it is hoped that some of these technical suggestions may be useful Undoubtedly, much of what appears in this technique will require change, and additions and deletions will undoubtedly occur within a very short time, nevertheless, this approach is being presented now because there appears to be a need for information on the technique of this very delicate and complex surgical procedure within the human temporal bone

This is not simple surgery Experience seems to indicate that this procedure in its present early form should be limited to the otologic surgeon who is skilled in fenestration surgery, for two reasons *1* He has the specific anatomical training and surgical dexterity necessary for intra-tympanic manipulations *2* The patient who is subjected to a stapes procedure is entitled to have available to him the fenestration operation if the stapes procedure is unsuccessful It is not logical that a patient be required to seek surgical help through fenestration at the hands of another surgeon if the stapes footplate cannot be mobilized

When the stapedolysis procedure is successful the advantages to the patient are important. Because of the preservation of the functioning tympanic membrane and ossicular chain, the hearing restoration is usually excellent. The surgical procedure is much simpler for the patient, from the point of view of short hospitalization, simple and brief postoperative course relative absence of side effects and discomfort.

TECHNIQUE

1 *Preoperative Care*

The preoperative medication for stapedolysis surgery should not be heavy It should be sufficient to produce a calm entry into the operating room but not deep enough to obtund accurate responses for audiometric threshold studies The patient should be slightly sleepy but not heavily narcotized For this purpose, barbiturates alone usually suffice Three grains of sodium pentobarbital are usually sufficient for this procedure, this medication is given in divided doses about two hours and one hour before surgery Morphine and its analogues are usually not used There is no need for atropine or similar drugs

2 *Preparation*

Hair preparation is kept at a minimum The hair is not shaved but is usually kept out of the surgical field by the use of a modified bathing cap or adhesive tape The head is placed with the opposite ear in a comfortable doughnut retainer, and the patient is asked to hold a push button for use in audiometric responses, and is instructed in the audiometric technique to be employed Usually, the same audiologic technician who examined the patient preoperatively does the operative audiometry

The peri-auricular area and the auricle are cleansed in the usual manner as for any surgical procedure Cerumen, dead epithelium and crusts are carefully removed from the external auditory canal by the surgeon, the canal is filled with a 1-1000 aqueous zephiran solution, and a trailer quarter-inch gauze is packed into the canal, completely covering the tympanic membrane

The purpose of this aqueous zephiran preparation is two fold *a* It is designed for antiseptic preparation, *b* It serves to create some edema of the tympanic membrane This is important inasmuch as some tympanic membranes are parchment-like and atrophic in their consistency, such tympanic membranes are very easily ruptured in the surgical exposure of the middle ear Preliminary contact of 15 to 20 minutes with aqueous zephiran solution creates sufficient edema in the epithelial layers of the tympanic membrane to permit easier elevation with little danger of perforation

3 *Anesthesia*

The cutaneous lining of the bony canal wall is adequately anesthetized by blocking with a mixture of 2 per cent xylocaine, three parts and 1-1000 adrenalin, one part, following Rosen's[8] recommendation A total of less than 1 cc of this mixture is needed for adequate local anesthesia of the entire cutaneous bony canal lining and the tympanic membrane The anesthesia solution is injected with a 3 inch 22-gauge short beveled needle at the four points of the circumference of the external canal at the junction of the bony and cartilaginous canal walls

The solution is allowed to dissect the subcutaneous tissue down towards the annular sulcus region Pressure is applied by means of small saline cotton balls to encourage subcutaneous dissection by the anesthesia solution medially, so that partial elevation of the annular flap is achieved

4 *Incision.*

The incision in the posterior half of the canal skin is omega shaped, starting superiorly at about the junction between the pars tensa and pars flaccida and ending at the inferior aspect of the annulus The apex of the omega is at the lateral extremity of the posterior bony canal wall The skin is dissected from bone with a slender periosteal elevator (see Fig 1)

The elevation is facilitated by gentle blunt dissection, using wet cotton applicators Several suture lines may be present depending upon the developmental anatomy of the os tympanicus When these suture lines are reached, they are carefully incised with a sharp knife (blunt dissection at these points should be avoided) This elevation of the dermal periosteal flap can be accomplished rapidly but should be done with magnification, using a loupe The elevation is carried medially until the margin of the annular sulcus is reached

5 *Annular Elevation, Opening of Middle Ear, and Exposure of Incudo-stapedial Joint*

When the margin of the tympanic sulcus is reached, a round angulated elevator is used to enucleate the annulus fibrosus from the sulcus Following the enucleation, penetration of the tympanic air space is accomplished The enucleation of the fibrous annulus from the sulcus is continued superiorly, and inferiorly, until exposure of the entire posterior half of the middle ear is obtained This exposure will be limited superiorly by the junction of the pars tensa and pars flaccida

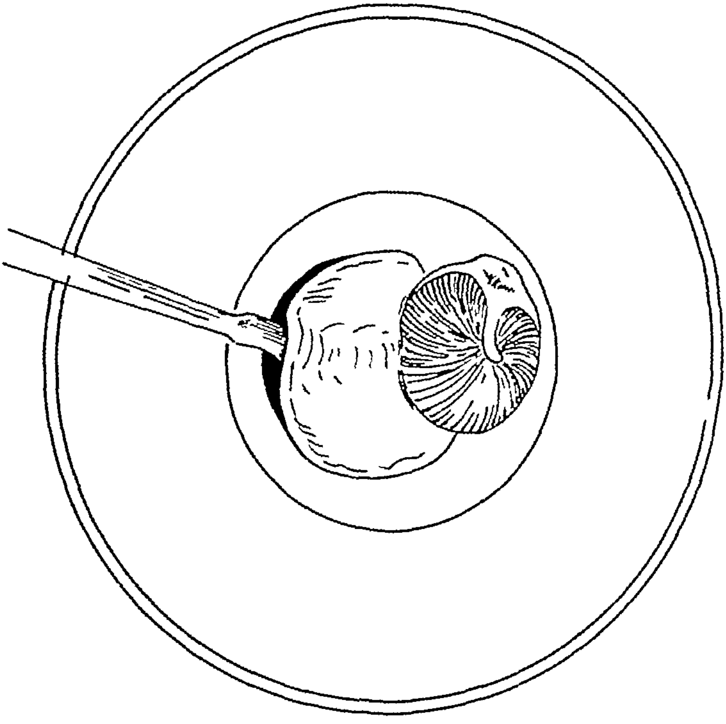

Fig 1 Elevation of annular flap

When this exposure is completed (see Fig 2), in at least 50 per cent of cases a direct view of the entire incudo-stapedial joint will be obtained, along with the chorda tympani nerve, stapedial tendon, part of the posterior stapedial crus and part of the anterior crus Occasionally the posterior aspect of the handle of the malleus will be seen The promontory and the round window niche will usually be prominently in the field

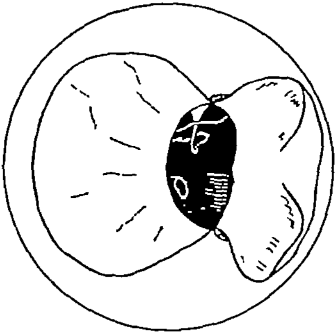

Fig 2 Excellent exposure of the incudo stapedial joint.

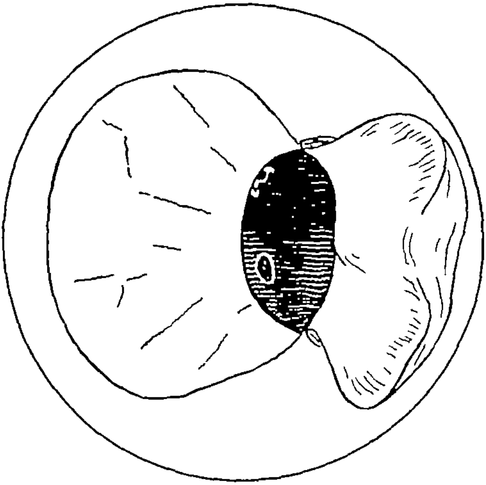

Fig 3. Poor exposure of the incudo stapedial joint.

If such a clear visualization is not easily obtained (see Fig 3), it is necessary to obtain adequate exposure by removal of sufficient postero-superior bony annular quadrant to make this possible This may be accomplished in some cases by the use of a sharp small curette In many instances, it can be accomplished only by the use of a small modified Lempert 1 or 2 mm burnishing burr on a contra-angle dental handpiece (see Fig 4)

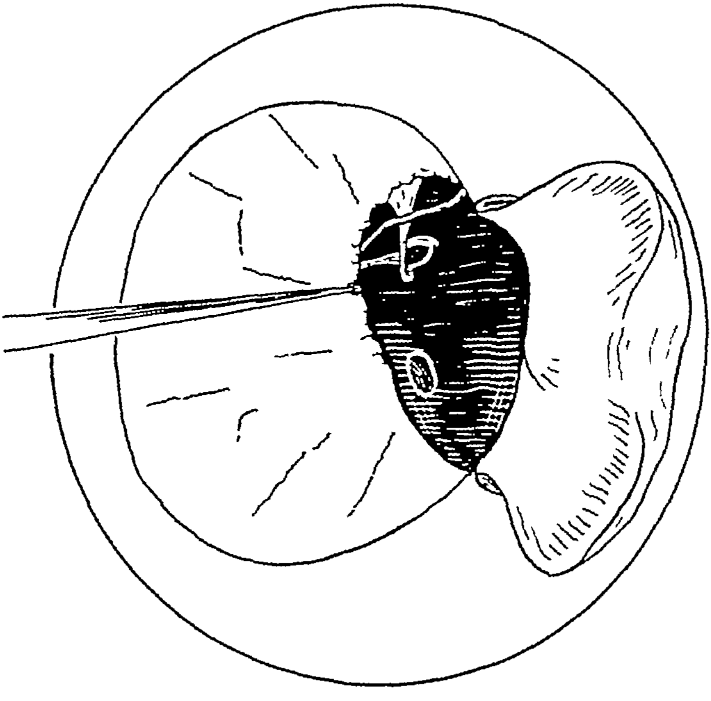

Fig 4 Removal of bone postero-superior annular quadrant for better exposure of incudo-stapedial joint

Such bone removal is done gently without trauma to the chorda tympani nerve, which can usually be pushed aside with little difficulty It is rarely, if ever, necessary to cut this nerve Sufficient bone in this quadrant should be removed to give an adequate surgical approach to the incudo-stapedial articulation

6 *Operative Audiometric Technique*

It is now necessary to describe the technique of operative audiometry utilized in this procedure, because its employment begins at this point. The audiometric purpose is to obtain comparative threshold levels for guidance in manipulation of the incudo-stapedial joint for stapedolysis These are relative and not absolute threshold values, such as might be obtained in an adequately sound-treated room Thresholds are obtained for air conducted sound at frequencies of 500, 1000, 2000 and 4000 cycles without masking of the opposite ear in the reasonably quiet environment of the operating room (without special acoustic treatment)

Surgical procedures are performed at times when extraneous ambient noise levels will be at a minimum, usually in the afternoon when all other operating rooms have been emptied The doors are kept closed, and extraneous disturbing noises are discouraged by operating room personnel (Ideally, of course, it would be fine to have available an acoustically treated operating room, but adequate relative studies may be done in an ordinary operating room under the circumstances described above.)

Any acceptable and calibrated pure tone audiometer may be used for this purpose A sterile field cover is draped over the operative field The audiologist places an air conduction receiver on the covered auricle and it is held in place by a sterile towel (see Fig 5) The same conditions are used for all four basic steps Consequently, the attenuation by the sterile field cover is a constant factor and can be disregarded since the purpose is relative threshold determination for threshold shift only

Four basic threshold determinations are necessary (In some instances, as many as six or seven threshold studies might be required during the progression of lysis attempts) The basic four studies are as follows *1* Middle ear closed after initial incision has been made and flap replaced, *2* Middle ear open[*], *3* Guidance threshold *after* manipulation through incudo-stapedial joint (This third step may require one or several repetitions to obtain evidence of either lysis or complete ankylosis) , *4* Middle ear closed again (this final step is made as a final estimate of the threshold shift as compared to *Step 1*)

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[*] We have noted the frequent occurrence of an improvement in hearing at 4000 cycles when the middle ear is open before stapedolysis

In some instances, it is advisable to employ *Step 4* as an extension of *Step 3*, when the threshold shift with *Step 3* is minimal Under these circumstances, it may also be informative to repeat *Step 4* several times In the average case, the minimum of the four steps is adequate, in some cases it is necessary to do more than four studies

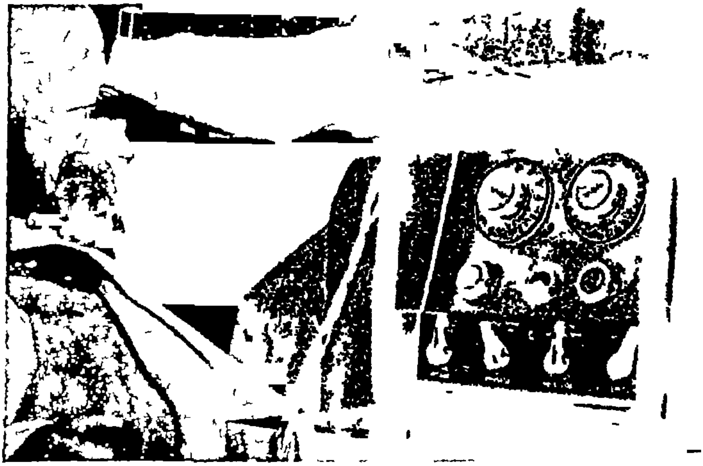

Fig 5 Illustration of technique for operative audiometry

7 Microscopic Study of Operative Field and Palpation of the Incudo-stapedial Joint

At this point in the procedure, it is usually advantageous to bring into use the dissecting microscope, which is a modified Bryan surgical microscope, with the addition of an infrared filter and a condensing lens to concentrate the light beam for use through an ear speculum It may require considerable manipulation of the position of the patient's head, the position of the speculum, and the angle of the microscope to accomplish adequate visualization of this area, but the advantages to be gained are well worth the slight inconvenience of such prolonged manipulation maneuvers

The various structures previously enumerated are inspected carefully with the microscope, and special attention is paid to the crura and the region of the stapes footplate It is not unusual to find pathologic atrophic fractures of the crura before any surgical attack has been directed to this area

In advanced otosclerosis with osteogenetic destruction of the stapedial footplate it is possible to find that the crura have been pathologically thinned, and actually replaced by fibrous strands in the region of the footplate, which is now no longer an anatomical footplate but a distorted bony area filling the fenestra ovalis, which in itself may demonstrate deformation of its margins

8 Trans incudal Manipulation to Produce Stapedial Footplate Lysis

It was observed on a number of occasions that mobilization of the stapes by the use of force directed toward the neck of the stapes, as described by Rosen,[8] would not infrequently produce immediate disruption of the incudo-stapedial joint. This is to be expected from an analysis of the mechanical forces involved in this procedure

The incudo-stapedial joint is an enarthrosis, a ball and socket joint with poly axial motion and no ligamentous limitation. Fenestration surgeons are familiar with ease of disarticulation of the lenticular process of the incus from the head of the stapes, thus, force applied to the stapes neck posteriorly may easily disrupt the incudo-stapedial joint.

I found that it was more feasible to direct the application of force to the incus itself and apply it through the incus to the stapes through the incudo-stapedial joint. It is thus possible in many instances to produce stapedolysis by trans-incudal force without concomitant incudo-stapedial dislocation.

A slightly curved sharp probe is inserted into the periosteal surface of the lenticular process and the integrity of the incudo-stapedial joint judged by palpation (see Fig 6) If exploratory pressure reveals that it is possible to transmit force to the stapes safely, *immediate lysis attempts are made*

If such exploration reveals a very loose incudo-stapedial joint, it is intentionally immobilized by cementing before force is applied (see Fig 7) Immobilization is accomplished by the use of pentocryl, a fast setting resinous plastic applied in a semi-solid state to the incudo-stapedial joint

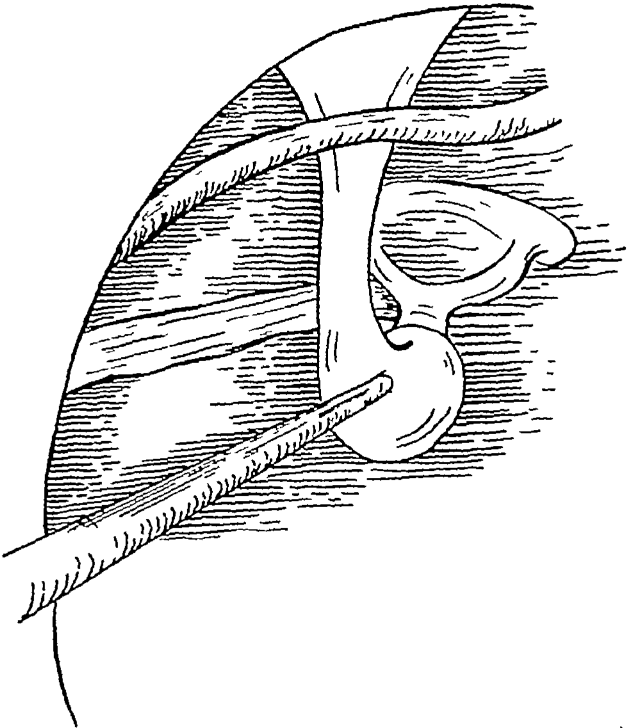

Fig 6 Trans-incudal mobilization of stapedio-vestibular joint.

When the incudo-stapedial joint appears relatively stable, either naturally or following pentocryl cementation, attention is directed to the stapedial muscle tendon This usually inserts on the posterior stapedial crus near the neck. If the tendon appears stretched and under tension, a fine angulated knife is passed underneath it at its insertion, and it is cut away from the stapes to prevent counter pull, which might favor either crural fracture or incudo-stapedial joint dislocation

When it is possible to apply force it is applied through the probe, first in a posterior direction and then in an anterior direction, occasionally inferiorly and occasionally superiorly and occasionally in a gently rotatory fashion Frequently, application of such force in any one of these directions is followed by a slight audible crack and the voluntary statement by the patient that there was a change in auditory threshold

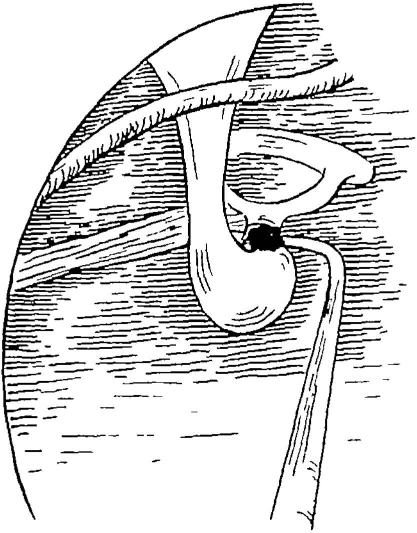

Fig 7 Cementing of incudo stapedial joint.

Common expressions made by the patient are, "something just opened up," "I felt something snap,' 'I felt a loud noise in my ear," etc. At such a point it is desirable to perform *Step 3* of the audiometric study If this *Step 3* shows an immediate improvement in threshold the middle ear is closed, and *Step 4* is performed If the threshold shift is 20 or more decibels in the speech frequencies, it is considered that significant lysis has been accomplished

If there is no voluntary statement by the patient, *Step 3* is performed after a series of forces have been applied in the

(Case No 31)

		Air Conduction				Bone Conduction			
		500	1000	2000	4000	500	1000	2000	4000
Preoperative Audiometry		40	40	35	35	10	15	5	10
Operative Audiometry	Step 1—Tympanum closed	50	45	40	50				
	Step 2—Tympanum open	60	60	40	30				
	Step 3—Tympanum open (after stapedolysis)	45	35	25	25				
	Step 4—Tympanum closed	25	25	35	55				
Postoperative Audiometry	2 weeks after surgery	30	25	25	25				

Fig 8 Operative Audiometry Chart. This illustrates a typical successful stapedolysis record Steps 1 2 3 and 4 illustrate the thresholds obtained under conditions described in the text.

(Case No 51)

		Air Conduction				Bone Conduction			
		500	1000	2000	4000	500	1000	2000	4000
Preoperative Audiometry		70	70	70	80	35	45	25	40
Operative Audiometry	Step 1—Tympanum closed	65	75	80	80				
	Step 2—Tympanum open	65	80	80	90				
	Step 3—Tympanum open (after attempted stapedolysis)	65	80	75	85				
	Step 4—Tympanum closed	70	80	75	85				
Postoperative Audiometry	2 weeks after surgery	60	65	65	75				

Fig 9 Operative Audiometry Chart This illustrates a typical unsuccessful stapedolysis record in a poor candidate (note bone conduction) Steps 1 2 3 and 4 illustrate the thresholds obtained under conditions described in text

various directions mentioned These forces are of very small magnitude, and are gently applied with every effort not to disrupt the incudo-stapedial articulation If operative audiometric *Step 3* shows no significant threshold shift with probe manipulation, it may be assumed that the ankylosis is of major degree (see Figs 8 and 9)

It was found that under such circumstances it was possible to produce lysis by mechanical rapid vibratory force if the continuity of the stapedio-vestibular articulation had not been destroyed by the otosclerotic process If observation with the dissecting microscope reveals severe pathologic crural or footplate changes, further manipulation is discontinued, and the operation is concluded

9 *Use of the Microvibrator in Trans-incudal Stapedolysis*

A microvibrator was devised, utilizing a dental handpiece with an 'amalpak" automatic hammer attachment, to which was added an offset right angle probe to transmit hammer like forces to the incus (see Fig 10) The rate of motion of the

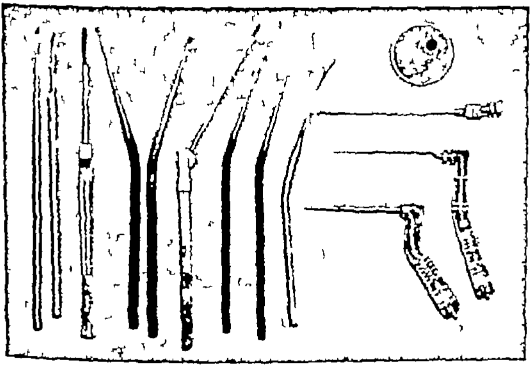

Fig 10 Instruments Used Basic instruments used in stapedolysis. A variety of bone elevators probes and scalpels are needed for the dissection and for manipulative purposes.

a. Illustrates the contra angle attachment to the dental handpiece for the use of a specially grooved burnishing burr

b Illustrates an automatic hammer attachment to the dental handpiece with an offset probe which constitutes the microvibrator described in the text.

vibrator is controlled by the foot control of the dental engine in the same manner as in the use of the burr The microvibrator probe is applied to the lenticular process of the incus The amplitude of motion of the microvibrator is less than 0 5 mm Exploratory bursts of vibration are utilized in varying speeds and results are observed visually and studied audiometrically

If use of the microvibrator in all four direction using varying speeds is not followed by an appreciable threshold shift, on *Step 3* audiometric run, the procedure is concluded with the assumption that the footplate region is ankylosed beyond the possibility of lysis by current surgical techniques

10 Closure of Incision

*When a decision has been made as to the status of the stape*diovestibular joint, the drum and skin flap are replaced closing the middle ear

11 Dressing

Upon replacement and final *Step 4,* audiometric evaluation, the wound edges are carefully approximated to their preoperative positions and covered by strips of rayon gauze saturated in saline All of the raw areas are covered, as is the entire tympanic membrane A cylindrical piece of nylon wool is impregnated with neomycin hydrocortisone "acetate F" ointment and placed within the lumen of the external auditory canal, and against the tympanic membrane, with concentric pressure against the rayon saline strips Two or three such pledgets are inserted into the external auditory canal to apply evenly distributed pressure in all directions A dry cotton plug is inserted as a final dressing to close the meatus No head dressing is deemed necessary

12 Postoperative Care

A Pain There is slight pain following this surgical procedure, but it is relieved by the use of aspirin, codein or demerol

B Ambulation The patient is allowed to be ambulatory as soon as the effects of the barbiturate medication have worn off

C Antibiotics Prophylactically, tetracycline 250 mgm four times a day for five days In patients sensitive to the mycin drugs, other suitable antibiotics or sulfonamides may be administered

D Vertigo Some patients will experience immediate slight or moderate vertigo, and in some instances nystagmus may be observed. Such vertigo is usually self limited within a few hours If it is annoying, it may be alleviated by small doses of dramamine by mouth, occasionally by injection

E Hearing The hearing level in the operated ear, which may be elevated at the time of surgery, usually drops in the postoperative period and may remain unchanged, or even lower than the pre-operative level, for the first five to seven days In many successful lysis cases, the Rinné test remained negative for seven to ten days following surgery, and then became positive

F Packing Removal. The dressing is removed gently on the seventh day If slight bleeding occurs, the wound is repacked and not disturbed for another five days, after which it is usually simple to remove.

When the packing has been completely removed, it will usually be observed that the flap is well healed, the tympanic membrane appears mobile and in most instances is translucent. Hemotympanum and serous effusion are encountered only rarely postoperatively and usually subside spontaneously No further dressing is employed after the packing has been removed It is rarely necessary to treat the canal with any type of medication

SUMMARY

A method has been described for the purpose of mobiliza tion of the stapes by the technique of trans incudal stapedolysis This new technique has been found effective in increasing the number of good results following this type of surgery

Special features of this technique include *1* Trans-incudal application of force, *2* Operative audiometric control, *3* Use of a mechanized microvibrator, and *4* Prevention of incudo stapedial dislocation by cementing

It is too early at this stage to report on results of such surgery, but such reports are planned when sufficient time has elapsed to warrant long range evaluation

The experience to date indicates that this may be a very useful procedure in an unknown percentage of otosclerotic patients In suitable cases, if the procedure produces long range results, it has many advantages over fenestration of the semicircular canal If irreversible footplate disease prevents stapedolysis, this technique will not prevent the possibility of a successful fenestration operation later

By no means does this procedure replace fenestration in the surgery of otosclerosis It is an added technique to the armamentarium of experienced otologic fenestration surgeons who are equipped by training and experience to do the delicate manipulations in this field and who can offer their patients a complete surgical rehabilitation program, so that if the stapedolysis procedure is not effective, fenestration may still be effective in surgical restoration of hearing

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AUDITORY FUNCTION AS RELATED TO THE COMPLAINT OF DIZZINESS

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Disturbances of the vestibular complex may excite such postural confusion and physical incapacity that the relatively less impressive sensation of hearing impairment may be temporarily unnoticed, especially during the initial stages of affliction The auditory segment of the temporal bone is normally the most sensitive but also the least resistant to a variety of insults, hence its functional integrity contains the diagnostic, prognostic and therapeutic key to a number of clinical symptoms associated with what the patient describes as dizziness It is up to the examiner to differentiate between labyrinthine vertigo and other types of postural or locomotor instability which may be called dizziness

Dizziness is a common complaint encountered in the practice of medicine and its connotations excite a multiplicity of diagnostic considerations which necessitate a series of complex and time-consuming examination procedures The most essential of these after securing an accurate and detailed description of the patient's symptoms, is the auditory survey preferably preceded by the otoscopic examination The otoneurologic examination should include routinely the differential caloric tests subsequent to a painstaking search for spontaneous or positional nystagmus

The information thus obtained along with that of the remaining neurologic examination X-rays of the internal auditory meatuses and ophthalmoscopic investigations[1] will facilitate a differentiation between peripheral and central types of dizziness upon which one may place relatively high diagnostic value.

There are few audiometric patterns which of themselves are

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typical or characteristic of specific etiology, however, tympanic and inner ear types of hearing loss can be identified, and evidence is accumulating that may make it possible to distinguish between at least two types of inner ear hearing loss[2] It is essential that the acuity of hearing for both air and bone conduction be determined in order to learn where to focus the search for the etiology of dizziness

Nearly all peripheral vestibular disturbances are accompanied by hearing loss, although there are a few exceptions which will be discussed presently Hearing loss is less frequently associated with central causes of dizziness, but in some cases it is the primary and cardinal symptom

Recruitment and threshold fatigue are peculiar phenomena of hearing which may be helpful in differentiating between cochlear and neural lesions[3 4 5] Recruitment may be defined as an abnormally rapid appreciation of loudness as the intensity of a given sound is gradually increased The Bèkesy type audiogram reveals this in the short excursions made by the recording pen which is actuated by the patient's signal response to pure tone threshold stimulation

Dix, Hallpike and Hood[6] noted that recruitment characterized hearing impairment of cochlear origin, as in labyrinthine hydrops, but that it did not accompany hearing loss of a neural nature, such as occurs from compression of the auditory nerve by acoustic neuromas

Auditory threshold fatigue may be defined as a decrease in threshold sensitivity resulting from successive exposures to sound which can just barely be heard Excessive fatigue at threshold has been reported as a significant finding in neural types of deafness but not present in cochlear hearing loss Reger and Kos[7] have noted temporary threshold fatigue in cases of acoustic neuroma and atrophy of the acoustic nerve Sufficient evidence has not yet accumulated to the extent that the interpretation of these observations may be accepted with complete confidence, however, they may be looked upon as potentially valuable diagnostic expressions of dysfunction which deserve exhaustive investigation

It is apparent that regardless of the initial causes these disturbances may be attributable to circulatory deficiencies due to vasomotor irregularities, nutritional insufficiency, or vascular occlusion The ultimate effect is an excitatory or degenerative activity extended to the functional segments of the temporal bone

In those instances in which the dizziness does not indicate or suggest serious consequences to life and for which no exact cause may be readily ascribed, either by otoscopic examination or neurologic evidence of disease, a complement of symptoms comprised of vertigo, tinnitus, hearing loss, nystagmus, and the associated autonomic phenomena is generally recognized as Meniere's Symptom Complex[8]

There are variations of this complex which regularly trace a symptomatic pattern suggesting an acceptable operational classification for diagnosis, prognosis and treatment that the expression Meniere's symptom complex does not clearly define[9]

LABYRINTHINE HYDROPS

The dizziness of labyrinthine hydrops (Meniere's disease) is a spontaneous rotating or spinning sensation, sudden in onset and aggravated by motion, which lasts from a few minutes to several hours The victim remains conscious and afterwards is usually able to give a detailed account of the attack however in some instances, the patient is so terrified and preoccupied with efforts to maintain balance that some essential features of the experience may escape his detection

Its spontaneous paroxysmal course is punctuated by varying intervals of well being, during which the general sensory and motor functions seem to be normal except for residual hearing impairment and tinnitus

The hearing loss is of the inner ear type usually unilateral, and early in the disease involves principally the low tones Eventually the hearing for all frequencies may be depressed One of the characteristics of labyrinthine hydrops is the fluctuation of hearing acuity during its initial phases

If the hearing loss is limited to frequencies below 1000 cycles and does not exceed 20-30 decibels, it may return to normal otherwise recurrent attacks apparently introduce the effects of chronic ischemia, with accompanying deterioration for high frequenices and a permanent residual hearing impairment Frequently an aura of impending attack is felt as a building up of "pressure in the ears" which is relieved following an attack Occasionally this relationship is reversed

Attacks vary considerably in duration, intensity and frequency from individual to individual, and they may occur for a period of several years without severe deterioration of the cochlear function A relatively rare variation, however, is one having a rapidly progressive course followed by complete destruction of hearing Paroxysmal dizziness may occur without evidence of hearing loss, and, contrariwise, at least temporarily a fluctuating inner ear deafness may occur without vertigo Such episodes usually eventuate in the more familiar

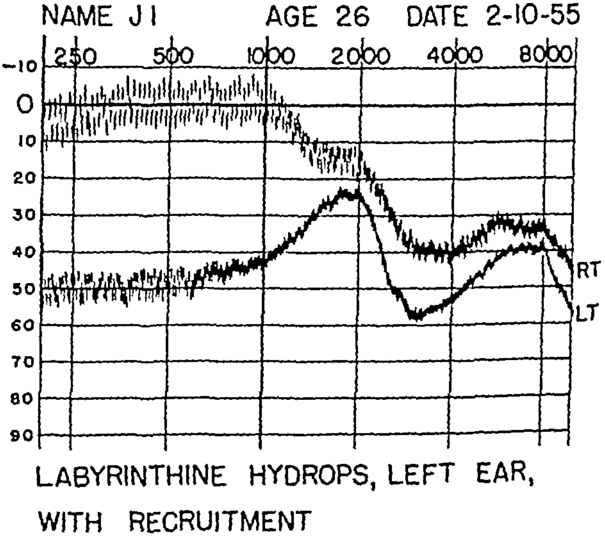
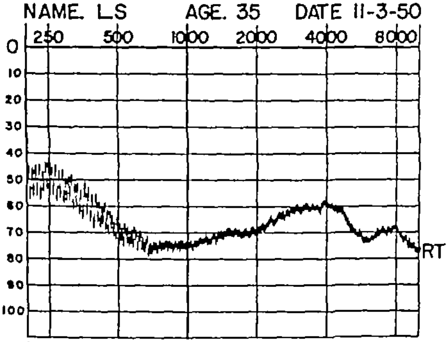


Fig 1 The narrow swings indicate recruitment

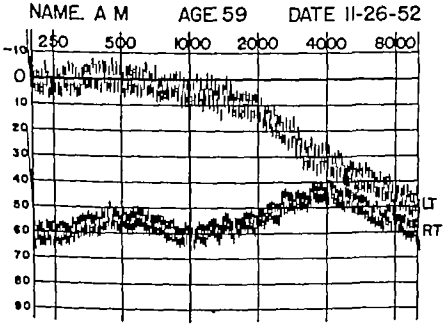
combination of effects Tinnitus is often described as a roaring, buzzing, or sizzling noise in the ear Its intensity rises and falls in some relation to the sensation of dizziness

Recruitment is observed audiometrically Usually it is not marked unless the hearing loss exceeds 30 decibels, and it is more severe for higher frequencies than for low (see Figs 1 and 2) In some patients, recruitment subsequently disappears, possibly because of the effects of chronic ischemia on the auditory nerve (see Fig 3)



LABYRINTHINE HYDROPS, RIGHT EAR, WITH RECRUITMENT

Fig



LABYRINTHINE HYDROPS WITH ISCHEMIA, RT NO RECRUITMENT

Fig 3

Threshold fatigue is not characteristic of labyrinthine hydrops, though it may be present to a slight degree in some patients whose attacks have been of several years' duration

Labyrinthine hydrops affects young adults as well as those of more advanced age, but its highest incidence is among those in the 35-45 age bracket

LABYRINTHINE ISCHEMIA

The dizziness of labyrinthine ischemia varies from a partial turning or segmental spinning sensation to one of oscillation and uncertainty of posture or position This is a degenerative process The dizziness occurs, not as distinct, spontaneous episodes, but rather as superimposed exacerbations on a persistent unsteadiness or locomotor instability Quick head movements, sudden postural changes or certain positional attitudes are definite exciting factors

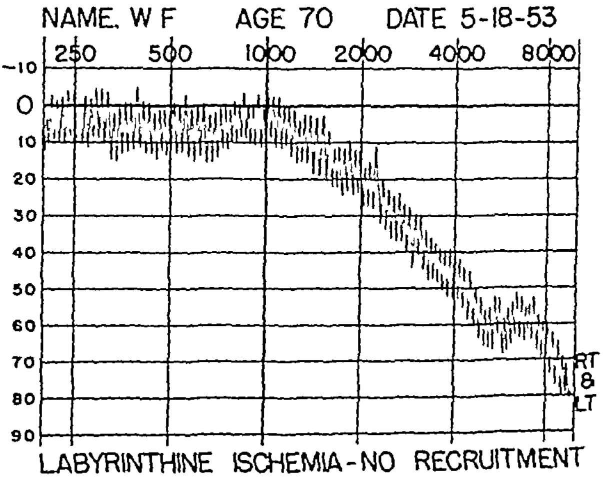


Fig 4

Intermissions of freedom from dizziness are experienced usually when the patient remains immobile, or when he learns to avoid the positions which bring on the discomfort The slightest change in position is likely to initiate a sensation of falling which lasts a few seconds to a few minutes, or may be prolonged for hours

A carefully taken history and painstaking inquiry will often reveal that labyrinthine ischemia is influenced by diurnal *physical activity One patient may complain that dizziness is* worse in the morning but recedes after a few hours of moving about Strong coffee is usually his favorite beverage, and several cups may be consumed before he feels like indulging in much activity Another may complain that his dizziness is worse in the afternoon or evening, during which he tires easily from normal activities. These are important clues to therapeutic management and symptomatic prognosis

The hearing loss, as distinguished from that observed in labyrinthine hydrops, is of the high frequency, inner ear type, and may or may not exhibit recruitment, presumably depending upon whether the end-organ or nerve is primarily affected (see Fig 4) It is usually bilateral

Hearing never fluctuates, but progressively deteriorates The tinnitus is described as whistling, ringing or squeaking, and sometimes is compared to the sound of a ricocheting bullet Some of these patients show evidence of auditory threshold fatigue in the absence of recruitment which suggests nerve involvement. One patient who did not reveal a recruitment response, but rather severe fatigue at threshold, was observed to have marked atrophy of the auditory nerve during an exploratory exposure which was done because she was suspected of having an acoustic neuroma (see Figs 5A and 5B)

This clinical picture indicates a slowly progressive disintegration of reflexes because the circulation provides less and less of the nutritive elements necessary to maintain efficient and effective labyrinthine activity There is no significant correlation in the finding of vascular hypertension or hypotension as the cause of this dizziness, but arteriosclerosis is a commonly associated condition

The period *of life in which this type of dizziness more fre*quently appears is the one upwards of 45 years of age.

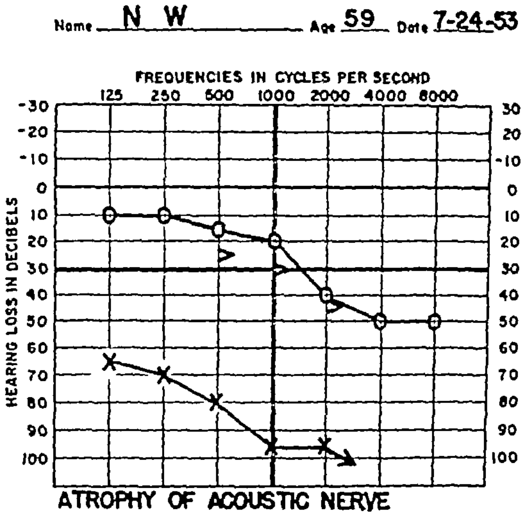


Fig 5A. Pure tone clinical audiogram showing severe impairment of hearing in the left ear Note the threshold of hearing at 500 1000 and 2000 frequencies for comparison with Figure 5B

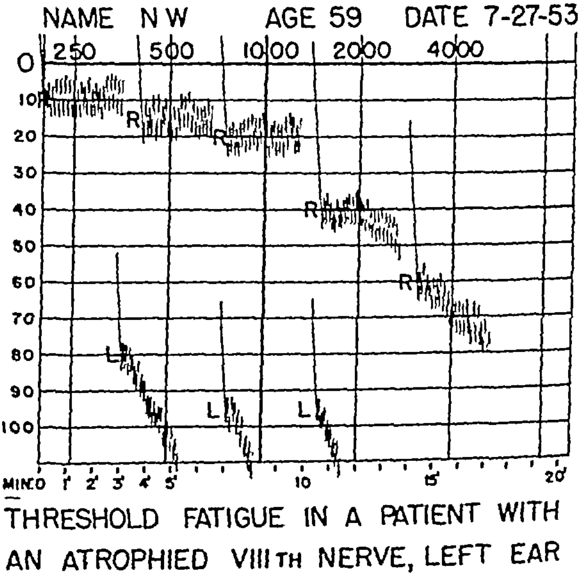


Fig. 5B Threshold recordings with the Bekesy type audiometer shows threshold shift in left ear at 500 cps from 80 db to 110 db in about two minutes at 1000 cps from 95 db to 110 db in about one minute at 2000 cps from 95 db to 110 db in less than one minute Note this shift does not occur in the right ear except slightly at 2000 and 4000 cps This audiogram differs from those previously shown in that the threshold was obtained at fixed frequency levels as is done in pure tone clinical audiometry i e the test frequency remains constant

LABYRINTHINE APOPLEXY

Acute labyrinthine anoxia, such as occurs as the result of labyrinthine ablation, vascular occlusion or severe, prolonged vasospasm, is often difficult to differentiate initially from a severe episode of labyrinthine hydrops, however, the nature of the disturbance is eventually established by the persistence and intensity of both subjective and objective symptoms The dizziness is a true vertigo, and its duration is several weeks during which time there is gradual improvement. Depending upon the physiological age of the patient, varying degrees of recovery from dizziness take place Vertigo and the tendency to sway persist longer in elderly people and may never cease The older the patient the less likely complete compensation will occur Young adults recover somewhat more rapidly and completely

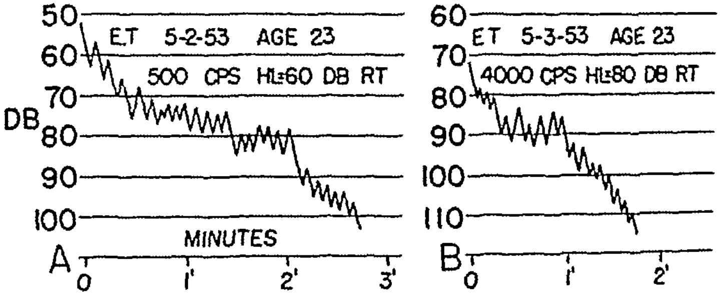
In some individuals, vestibular excitation may be partially restored after several months, but hearing loss which is usually severe is permanently established Tinnitus is invariably present and is high pitched Isolated insults may offend either the cochlear or vestibular organ separately The hearing loss when present is unilateral During the past ten years several young adults have been observed who sustained vestibular apoplexy without impairment of hearing

Recruitment is not of diagnostic significance in labyrinthine apoplexy as the hearing loss is usually too severe to obtain reliable measurements, however, when hearing is measureable recruitment may not be present.

ACOUSTIC NEUROMA.

Hearing impairment is the most frequent initial symptom of acoustic neuroma which also causes dizziness.[10] These patients usually are seen first by the otolaryngologist who, unless he conducts a very meticulous neuro-otologic examination, is apt to overlook the true significance of the hearing loss There is nothing characteristic about the pure tone audiometric test results except that they denote a non middle ear type of impairment and that recruitment is absent. Threshold fatigue is notably present (see Fig 6) These findings associated with the other familiar signs and symptoms which appear in acoustic neuroma have appreciable diagnostic value.

Rarely midline brain tumors give rise to discrepancies in hearing as an initial clue In a case of pinealoma the earliest symptoms were dizziness and difficulty in understanding speech Parodoxically hearing for interrupted pure tones as tested with a clinical audiometer was normal The patient was immediately suspected of malingering, but this consideration was soon dispelled when it was found that the Bèkesy automatic stepless intensity type of test showed rapid threshold fatigue without evidence of recruitment



THRESHOLD FATIGUE IN A PATIENT WITH AN ACOUSTIC NEUROMA

Fig 6A and 6B Threshold fatigue at 500 cps from 60 db to 100 db in two minutes 45 seconds at 4000 cps from 80 db to 110 db in one 46 seconds

Speech discrimination tests revealed very poor appreciation responses, but this alone may not be considered diagnostically significant of a central lesion In a matter of a few weeks papilledema and subsequent exploratory surgery confirmed the suspicion of intracranial involvement As the result of palliative surgery the patient has recovered his full powers of hearing, no longer shows threshold fatigue on the Bèkesy test, and is currently being observed for eventual changes which are expected to occur

Multiple sclerosis early in its course may give rise to differential diagnostic speculation Hearing loss is usually slight if present, but vertigo may be severe Recruitment does not occur but excessive fatigue at threshold may be exhibited

These are only a few of the clinical perplexities of which alterations in hearing may provide the key to earlier and more accurate diagnosis Despite the protests that accurate hearing tests may be inconvenient or difficult to obtain, audiometry and audiology are essential to those who undertake the responsibilities of managing the complaints of otologic origin or expression such as dizziness

CONCLUSION

Auditory symptoms associated with dizziness may be overlooked by both patient and physician because of their respective preoccupation with the relatively more alarming symptom of dizziness

Auditory impairment and some of the peculiarities associated with it (*e g,* recruitment, threshold fatigue) often are helpful in determining the general area of insult.

Auditory impairment for pure tones may trace suggestive patterns which when correlated with the results of a thorough examination lend considerable support to reliable diagnosis

Auditory function is frequently the important clue to the definition of dizziness

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SECRETORY OTITIS MEDIA REQUIRING MASTOIDECTOMY

WILLIAM J HITSCHLER, M D ,

Philadelphia, Pa

Although it is extremely unusual for secretory otitis media to require mastoidectomy, the procedure has been recorded[1]

The patient was a white woman of 40, in good health and with no past history of note She had had no ear trouble nor allergies

A week before being seen in my office, she had had a nosebleed (no other history of nasal trouble of any kind) Her nose was packed by another doctor This stopped the bleeding, but caused her to have pain in the ear on that side (left) There was no post nasal pack. The pain remained after the packing was removed The doctor told her that her ear was normal despite the pain. When she came to me the pain had subsided, but in its place was a most distressing full feeling and tinnitus She did not complain of hearing loss

Examination showed no demonstrable upper respiratory infection or sinusitis, nor were her membranes allergic looking The right ear drum was normal The left ear drum was slightly full, had a yellow cast inferiorly and was immobile The eustachian tube was catheterized under direct vision Air bubbles were then seen through the drum A myringotomy was done and clear, moderately thick, yellow fluid was obtained The symptoms as noted above disappeared at once The ear drained for two days During this time there were no disturbing symptoms

On healing (third day), the symptoms returned The left eustachian tube was again catheterized, and air bubbles were again seen, but there was no relief from her symptoms A few days later another myringotomy was done, again with immediate relief A culture and smear of the fluid was taken. The smear was negative, no cells whatsoever were seen The culture showed pseudomonas aeruginosa, which was moderately sensitive to Terramycin This was given, 500 mg t.i d for ten days, and also Terramycin ear drops No relief was obtained

Several subsequent myringotomies were then performed with similar results, i.e , complete relief from symptoms while the ear drained (usually two to three days), and return of symptoms on healing A second culture was negative On several occasions it was noted that more fluid was obtained than the middle ear could possibly hold The character of the fluid remained as described above Subsequent smears were negative

Allergic tests were performed They were negative, nevertheless, antihistamine therapy was tried, but without success Radium was then applied to the nasopharynx, again without success

Audiometric and fork tests (repeated) showed the following Right ear was normal, left ear normal bone conduction, but air conduction varied between a 30 to 40 decibel loss throughout the frequencies Fork

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tests showed bone conduction greater than air conduction on the left, and the Weber lateralized to the left.

After several more myringotomies (four months after the onset) a very large incision was made in the drum and a polyethylene tube inserted as described by Armstrong[2] This was left in place for three weeks During this time the patient was happy and symptom free however upon removing the tube the drum healed and all symptoms returned Thyroid extract by mouth was tried without success.

A mastoid X ray was then taken. It showed localized changes suggesting a chronic osteotitis Mainly because of the distressing symptoms a simple mastoidectomy was performed. This was eight months after the onset of the disease The following was found clear amber fluid welled up to the surface as soon as the perforating drill was withdrawn

On removing the cortex, there was seen to be bone softening and cellular destruction near the antrum Pink fibrous tissue was also present in this area and covered the incus head and neck of the malleus semicircular canal and surrounding bone. It had to be scraped off to expose these structures. It also was seen protruding from the middle ear The mastoid cells distant from the antral region were normal

A complete simple mastoidectomy was done including the removal of as much of the fibrous tissue from the middle ear as was possible without dislocating the ossicles. This fibrous infiltration in the antibiotic era mastoiditis was described by Tamari and Szanto in their histopathological studies.[3]

Hotchkiss[4] performed a mastoidectomy for secretory otitis He found much fluid in the mastoid cells but no bony destruction or fibrous tissue infiltration. He was "impressed with the normalcy of the mastoid structures."

Post-operatively the disturbing symptoms were relieved and have continued so to the present (five months after operation) The wound drained for seven weeks then became dry

Although she does not, nor ever did complain of hearing loss, her hearing is not improved.

CONCLUSION

Mastoidectomy for secretory otitis media is most unusual In this case the procedure accomplished what was urgently desired by the patient relief from her very distressing fullness and tinnitus, but it did not restore her hearing Undoubtedly, the reason for the hearing loss was the presence of fibrous tissue in the middle ear The thought arises would the hearing loss have been prevented by a mastoidectomy early in the disease? More study will be required to determine when and if such surgery should be performed in cases of secretory otitis media.

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1 Summit St.

UNIVERSITY OF ILLINOIS ANNUAL ASSEMBLY IN OTOLARYNGOLOGY

The Department of Otolaryngology, University of Illinois College of Medicine, announces its Annual Assembly of Otolaryngology from September 19 through October 1, 1955 This Assembly will consist of two parts

Part I — September 19 through September 24, 1955, will be devoted to surgical anatomy of the head and neck, fundamental principles of neck surgery and histopathology of the ear, nose and throat. This week will be under the personal direction of Maurice F Snitman, M D

Part II — September 26 through October 1, 1955, will be devoted entirely to lectures and panel discussion of advancements in otolaryngology The chairman of this section will be Emaneul M Skolnik, M D

Registration is optional for one or both weeks For further information, address Dr Francis L Lederer, 1853 West Polk St, Chicago 13, Ill

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POST-GRADUATE COURSES AT TEMPLE UNIVERSITY

The following Post-Graduate Courses to be given in this Department during the current year

Post-Graduate Course in Broncho-Esophagology, October 17 - 28, 1955

Post-Graduate Course in Laryngology and Laryngeal Surgery, September 19 - 30, 1955

These courses are all to be given in the Department of Laryngology and Broncho-esophagology, Temple University Hospital and School of Medicine, under the direction of Dr Chevalier L Jackson and Dr Charles M Norris The tuition fee for each course is $250 00 Further information and application blanks can be obtained from Dr Chevalier L Jackson, 3401 N Broad Street, Philadelphia 40, Pennsylvania

SOUTH CAROLINA SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

Plans have been completed for a joint meeting of the North Carolina Eye, Ear, Nose and Throat Society and the South Carolina Society of Ophthalmology and Otolaryngology at Columbia, S C, on September 12, 13, and 14, 1955 Headquarters will be the Columbia Hotel

The following ophthalmologists will be on the program Dr E W D Norton of New York, Dr Frank Carroll of New York and Dr William B Clark of New Orleans

A most attractive program has been arranged For further information address Roderick Macdonald, M.D, Secretary and Treasurer, 330 East Main Street, Rock Hill, S C

SOUTH AFRICAN LOGOPEDIC SOCIETY

The South African Logopedic Society (Society of Speech Therapists) publishes a Journal in May and October of each year Articles deal with the organic and psychological aspects of speech defects, and include subject matter of interest to the medical and allied professions.

Relevant contributions in the field of otolaryngology are invited

Subscriptions are 10/– per annum including postage and should be addressed to The Editor, Journal of the S A Logopedic Society, Witwatersrand University, Milner Park, Johannesburg, So Africa

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THE AMERICAN OTORHINOLOGIC SOCIETY FOR PLASTIC SURGERY Inc.

A short course on Plastic Surgery of the Head and Neck will be given by The American Otorhinologic Society for Plastic Surgery at the Morrison Hotel, Chicago, Illinois, extending from October 7 to October 9, 1955, inclusive For details write Dr Louis J Feit, 66 Park Avenue, New York, N Y

SECOND GRADUATE COURSE IN PLASTIC SURGERY OF THE HEAD AND NECK

American Otorhinologic Society For Plastic Surgery
October 7th to 9th, 1955 inclusive
at the Morrison Hotel, Chicago, Illinois

An intensive course in Plastic Surgery of the Head and Neck will be given at Morrison Hotel, Clark and Madison Streets, Chicago, Illinois, from October 7 - 9 inclusive, 1955

The course will be conducted by a faculty of outstanding specialists in this field and will be limited as to the number of participants and to recognized surgeons specializing exclusively in Otolaryngology and Ophthalmology and Plastic Surgery of the Head and Neck as set forth in the Directory of the American Medical Association For further information address Louis Joel Feit, M D , Secretary, 66 Park Ave , New York 16, N Y

53rd CONGRES FRANCAIS d'OTO-RHINO-LARYNGOLOGIE

The Fifty-third Congres Francais d'oto-rhino-laryngologie will be held Octobre 17-22, 1955 in the Grand Amphithéâtre of the Faculté de Médecine, Paris, under the présidency of Mr le Professeur A. Aubin of Paris, and honorary president Mr le Professeur Léon Binet, member of the Institute, Doyen of the Faculte de Médecine of Paris

Numerous communications will be presented and two reports of particular interest will be discussed

1°) L'otite chronique de l'enfance
Rapporteurs MM Bourdial, Debain, Coussieu, avec la collaboration d'Yves Lallemant (Paris)

2°) La déglutition et ses troubles
Rapporteurs MM Mounier-Kuhn (Lyon) et A Soulas (Paris)

There will also be an exhibit of surgical instruments and other armamentarium of interest to otorhinolaryngologists For further information address Mr Raimon, 17 rue de Buci, DANton 55-24

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BRONCHOESOPHAGOLOGY COURSE

The next Bronchoesophagology Course to be given by the University of Illinois College of Medicine is scheduled for the period October 24 to November 5, 1955, under the direction of Dr Paul H. Holinger

Interested registrants will please write directly to the Department of Otolaryngology, University of Illinois College of Medicine, 1853 West Polk Street, Chicago 12, Illinois.

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RHINOLOGY IN CHILDREN

RESUME OF THE LITERATURE FOR 1954

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This resumé of the literature on Rhinology in Children comes from the Hospital for Sick Children in Toronto, and the Department of Otolaryngology of the University of Toronto The medical journals, including the pediatric publications of the United States, Britain and Canada, have been reviewed The classification of previous years has been maintained

GENERAL ARTICLES

Dodwell[1] in the latest edition (the sixteenth) of *Principles and Practice of Medicine*, orginally edited by Osler, defines status lymphaticus as "a combination of constitutional anomalies, among which are hyperplasia of the lymphoid tissues and of the thymus gland hypoplasia of the cardiovascular system and peculiarities of configuration with frequent sudden death"

Results of the condition are various, among them are *1* Liability to sudden death—this may be from anaphylaxis cerebral hemorrhage or, in young children, pressure on the trachea by the enlarged thymus gland, *2* Increased suscepti

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bility and decreased resistance to acute infections, *3* Increased danger in childbirth, and *4* Psychical instability—these subjects forming a large proportion of cases of drug addiction and suicides

The most circumstantial account of the condition is given by Hewer (1953) According to him the findings of Kemp (1932), Campbell (1937), Moncrieff (1938), and the late Sir Bernard Spilsbury, in spite of several attempts to discredit their work, have definitely established the existence of the syndrome It would seem that Hewer bases his case that status lymphaticus exists as a clinical entity upon three claims

1 That the condition has been recognized for some 300 years

2 That there is a recognized clinical picture with three classical signs

3 That there are well-recognized post-mortem findings

Dodwell proposes to show that not one of these claims is supported by the available evidence

If Dr Hewer's story were correct we should expect to be able to follow these references to status lymphaticus back to the earliest editions of current works, and further back still in the earlier editions of books now out of print but in existence before Osler's *Medicine* was produced

Actually there is no reference to the condition in Osler's first and second editions, nor in any contemporary medical or pathological book Dodwell has been able to discover In fact it is not until the third edition of Osler's *Medicine*, published in 1898, that any reference is made, and then in these terms "Much attention has been paid lately to a somewhat rare condition ," and the reader is advised to consult an article by Ewing (1897)

Ewing in discussing the views of Paltauf (1889) begins "There have recently been described a series of cases " He continues "The importance of the constitutio lymphatica and its relation to some forms of sudden death, especially to fatalities under chloroform narcosis, have been recognized by the Vienna school of pathologists, but have received very scant attention elsewhere"

Six successive editions of Osler's *Medicine* carried the passage based upon Ewing's article but without his final sentence, which ran "In conclusion, while the studies of the Vienna observers seem to have placed the existence of the constitutio lymphatica upon a firm basis in pathology, the observations yet remain far too limited fully to demonstrate the truth of an hypothesis which connects a large class of sudden deaths with simple hyperplasia of the lymphatic structures of the body"

It is surely significant that Paltauf, in a long list of references, makes no mention of any work published earlier than 1850, equally so that John Simon (1845)—although his bibliography is immense going back as far as Galen and Rufus of Ephesus—seems entirely to have missed this historical association.

The history of the growth of the legend of status lymphaticus can be quickly told Gradually during the first decade of the twentieth century the idea of a status lymphaticus began to spread, so that in the eighth and ninth editions of Taylor's *Practice of Medicine* in 1908 and 1911 references begin to appear, and in 1911 for the first time a separate entry of diseases of the thymus gland makes its appearance in the annual report of the Registrar-General for England and Wales

In 1917 Dr Symmers, professor of pathology at the Bellevue Hospital New York, published an original work upon status lymphaticus in which he recorded the weights of the thymus gland in 66 cases out of 249 which he had diagnosed "status lymphaticus"

The weakness of Dr Symmer's case is that he publishes no standard for normal weights of the thymus gland, and if we compare the weights of his enlarged glands with the normal weights arrived at by Hammar (1916) or by the Medical Research Council's Joint Committee (1931), whose findings were based on a much larger published collection, we find that a preponderance of these abnormally heavy glands of Dr

Symmer's fall within these other observers' normal weights, however, Dr Symmer's views have gained much popularity and have formed the basis of the description of the condition in Osler's *Medicine* from the eighth edition, of 1920, to the latest, (the sixteenth), published in 1947

The legend of the 300-year-old tradition was not launched in British medical literature until the appearance of the second edition of Hewer's *Recent Advances in Anesthesia and Analgesia,* in which an article by Platter is quoted The latter died in 1614 a few months after the publication of his work *Observationum in Hominis Affectibus,* a reprint of which is to be found in the library of the Royal Society of Medicine

Platter's name was brought to the attention of American medical men in 1912 by C G Cumston, but his name does not appear in connection with status lymphaticus until 1924, when Ruhrah commented "To pediatrics we know he made one contribution of great value, the description of thymus death"

With regard to the recognized clinical picture, the three classical signs are mentioned for the first time by Kemp (1932), who quotes no case notes to support his statements No other writer records cases presenting these physical signs Campbell (1937) lists an impressive number of physical signs, far too numerous to be mentioned here, associated with status lymphaticus but, like Kemp, fails to favor us with any case records

That there are well recognized post-mortem findings is not supported by text books of pathology, although the writers of such works must have much greater experience of the post-mortem findings in such cases

Thus Boyd (1947) states that "there is no proof that the thymus gland has anything to do with stoppage of the heart" Dible and Davie (1950) state "There is no doubt that ignorance of the great variation in size to which the thymus gland is subject in health and disease has often led to an unjustifiable resort to the convenient diagnosis of status lymphaticus in cases of sudden death Many pathologists of experience are of the opinion that there does exist some abnormal constitution or condition which is associated with a liability to sudden death from relatively trivial stimuli, such as excessive sensitivity to stimuli of the autonomic nervous system but no constant anatomical or pathological abnormality"

Muir (1951) quotes the findings of the Joint Committee of the Medical Research Council and of the Pathological Society of Great Britian and Ireland, its general conclusions being that the facts that have been ascertained afford no evidence that the so-called status thymo lymphaticus has any existence as a pathological entity

The conclusion in Muir's textbook is that "this does not imply that there is not a constitutional condition of low resistance power, with a tendency to sudden death, simply that it is not possible to relate it definitely to thymic or lymphoid hyperplasia"

As to Sir Bernard Spilsbury's post-mortem findings in status lymphaticus, the authors have been completely unsuccessful in their attempt to discover any published work in which such findings are quoted In 1926 there was set up a Joint Committee of the Medical Research Council and of the Pathological Society of Great Britian and Ireland, which published its report in 1931 Some 680 post-mortem examinations were made, and the care and detail with which these cases were analyzed place this investigation in a class by itself

The diagnosis of enlarged thymus glands by X-ray is a very unreliable basis, as the writings of Garland (1929) and of Capper and Schless (1934) have emphatically shown

The author suggests that were this account of status lymphaticus other than a fable ample material in support could have been found among the thousands of post-mortem examinations reported since 1945 by Helpern and Rabson (1945), Keith Simpson (1947), Richards (1947), Deadman (1947) and others or from among the 200 odd deaths reported annually by the Registrar-General for England and Wales

In conclusion the authors believe that the 12 conclusions of the Joint Committee of the Medical Research Council and of the Pathological Society of Great Britain and Ireland remain the considered judgment of informed opinion, and that the last sentence of their report holds good "In the opinion of the Joint Committee the facts elicited in the present inquiry are in harmony with those of Hammar (1926, 1929), and of Greenwood and Woods (1927) in affording no evidence that so-called status thymo-lymphaticus has any existence as a pathological entity"

Because periorbital edema is often associated with acute ethmoiditis in children we present here a case report by Bass[7] of periorbital edema as the initial sign of infectious mononucleosis This 12-year-old girl came home from school feeling tired and with a temperature of 104 8°F The most striking feature on examination was the condition of her eyelids and periorbital tissues The eyelids were definitely puffy but not reddened There was no tenderness over the antra or ethmoid sinuses The throat and tonsils were not inflamed The urine was normal on examination Because of these findings and a negative allergic history, infectious mononucleosis was suspected There were no lymph nodes and the spleen was not palpable, but a blood smear showed the typical findings of infectious mononucleosis The cause of the lid edema is obscure, but may be due to lymphatic obstruction, even if no peripheral lymph nodes were palpable

Evans[3] in a long article with ample bibliography reviews the treatment of epistaxis which although commonly easy to correct may at times constitute a difficult surgical emergency

He states that the incidence is highest in children but seldom serious Often the simple nose bleed will stop spontaneously regardless of treatment used, or even without treatment Although this is true, it must also be remembered that to the patient this fact may not be known or obvious Whenever the bleeding from the nose is of sufficient severity that a physician is consulted, it is to the patient, or to his family, a serious matter and sometimes a frightening occurrence

For this reason, reassurance is the first step in treatment If the patient is at home, instruction should be given that he should be placed in the proper position, that is, that he should sit up and bend forward If he lies on his back, the stomach may fill with blood, causing faintness and nausea In cases of simple nose bleed from the anterior septum, blowing out the clots and pressing the anterior nares together for a few minutes may be sufficient to control the condition.

Whenever intranasal manipulation or packing is needed, the administration of a sedative is indicated, whether the patient be a child or an adult Once his anxiety is relieved and he becomes relaxed, whatever measures are necessary to control the bleeding are much more easily accomplished In cases of anterior nasal bleeding from Kiesselbach's or Little's area, the bleeding vessel can frequently be seen, if the hemorrhage is not too profuse, then the area is cocainized and cauterized either with one of the chemical agents or the electric current.

In attempting to control hemorrhage from the anterior part of the nose of a child, his associates and he prefer the use of chemical cautery to electrocoagulation. In many instances, they use a solution of 50 per cent silver nitrate which is immediately neutralized by sodium chloride solution and covered with holocaine and adrenalin ointment. Some authors suggest the use of a silver nitrate stick or chromic acid or trichloracetic acid, the latter two should be neutralized by a solution of sodium bicarbonate.

When the hemorrhage in the anterior portion of the nose is so severe that it is impossible to find the bleeding point, the nose is packed with cotton pledgets saturated with cocaine and adrenalin until the hemorrhage ceases Then an attempt is made to find the bleeding point in order that the area may be cauterized

When the hemorrhage is from the anterior superior part of the nose, and especially when there is a history of recurrent or profuse bleeding, he has found it most satisfactory to use 'spot' packing of oxidized cellulose or gel foam saturated with thrombin and held in place with a cotton sponge and a small piece of adhesive placed over the nostril to prevent the pack from being dislodged by sneezing The cotton should be saturated with penicillin solution to reduce the chance of infection. He also administers an antibiotic systemically if the pack is to be left in place as long as 24 hours

In case of recurrent nasal bleeding in children, which the parents usually say is spontaneous and frequently comes on at night, there is often a discharge with crusting of the septum near the anterior nares which may be due to infection or to allergy The child with allergic rhinitis has a tendency to rub the nose to relieve the itching sensation and to pick at the crusts with the finger Excessive drying of the nasal mucus greatly reduces its protective value and renders the capillary bed more accessible to trauma

A measure devised by Hilding and recommended by Hunnicutt is helpful in preventing crusting and allowing the tissues to return to normal, this is to place a light plug of dry cotton in the nostril for a few minutes several times a day In cases in which any nasal discharge is present, it is important that appropriate treatment for the underlying condition be instituted

In all instances of continued or recurrent epistaxis in children, a thorough clinical examination and appropriate laboratory studies are indicated, to determine whether the bleeding is being caused by some systemic disease Nasal hemorrhage of systemic origin in children is frequently noted in diseases of the blood, liver or kidneys, and in acute rheumatic fever In such instances, treatment of the underlying disease is of paramount importance, with the local measures which are necessary for the control of bleeding from the nose

SINUSITIS

Asked "to what extent does bone regeneration occur in the lateral wall of the nose after antrostomy", the British Medical Journal[4] replied as follows

"After antrostomy, a certain amount of new bone formation occurs around the edges of the opening made between the antrum and the inferior meatus of the nose, and if small fragments of bone are left adherent to the mucous membrane of either nose or antrum the new bone formation is more likely to occur This is more likely to occur in children and where there is persistent infection The bone formation causes progressive narrowing of the opening until it may become completely closed, and the thin layer of bone separating the two cavities may be replaced by a thicker and tougher one There is however, no encroachment on the cavity of the nose or antrum"

Marañon and Armengaud[5] examined the radiographic images of 365 normal children of both sexes, of average height for their age (between 3 and 19 years), in addition to a much larger number of radiographs of children suffering from various pathological conditions, and came to the following conclusions

a The dimensions and shape of the sphenoidal sinus are subject to wide individual variations

b The chronology of the development of the sphenoidal sinus is graphically represented in a diagram.

c The sphenoidal sinus is first visible at a fairly constant age, ranging between three and three and one half years The limits of the sinus are clearly distinct at about eight years of age At 16 its posterior limit reaches the plane of the posterior limit of the sella turcica Normally it does not increase after 16 years of age

d. In conditions of pituitary insufficiency, congenital or acquired early in life, the development of the sphenoidal sinuses is hindered in variable degree This underdevelopment is seen in pituitary dwarfism and infantilism in myxoedema of pituitary origin, and in mongolism The sphenoid is frequently solid in growth disturbances associated with embryopathies of different type—namely, achondroplasty and other conditions In cases of underdevelopment associated with disorders not directly connected with the pituitary gland like rickets and other deficiency conditions, the development of the sphenoidal sinus is the average for the age

e The degree of underdevelopment of sphenoidal sinus is roughly speaking parallel with the degree of the hypothalamo-pituitary insufficiency It constitutes therefore one of the indices of this hypofunction, especially in cases of pituitary dwarfism and infantilism. In cases of pituitary myxoedema the underdevelopment of the peripheral skeleton (wrist knee) is usually more pronounced than that of the sphenoidal sinus.

In mongolism, the underdevelopment of the sphenoidal sinus, very important on account of its frequency of occurrence, is not usually connected, according to their own experience with the degree of the condition

f The underdevelopment of the sphenoidal sinus is not exactly parallel with the underdevelopment of the other sinuses For instance, there may be a marked underdevelopment of the sphenoidal sinus with slight underdevelopment, or even normal development, of the frontal sinus, and more often, an underdevelopment of the sphenoidal sinus may be associated with a marked mastoid pneumatization

g The underdevelopment of the sphenoidal sinus is usually associated with other deformities of the skull, such as variations in the size and shape of the sella turcica—extremely hypoplastic, or enlarged due either to congenital hypofunctional tumors (cranio-pharyngiomata) or to conditions marked by internal hydrocephalus

h In cases of constitutional or pathological (acromegalic) pituitary hyperfunction the sphenoidal sinus develops intensely, generally simultaneously with the other cranial sinuses

The final conclusion is that the detailed study of the sphenoidal sinus is absolutely necessary when examining a pathological cranium, especially in cases of growth disturbances

BACTERIOLOGY

Disorders of the nose and pharynx constitute a large part of illness in pediatric practice, according to Goldman and associates[6] It is important to determine whether an infectious or non-infectious process exists in the proper management of the rhinologic disorders Many nasal problems have as their basis a vasomotor rather than an infectious disturbance, but if an infectious process exists the effectiveness of therapy depends on the knowledge of the infecting agent One should also know whether the source of infection is the adenoid or the paranasal sinuses

The authors of this study feel that the best information may be obtained from bacteriologic examinations Fifty chil dren from 4 to 12 years of age were chosen for this investigation They were all admitted to hospital during the winter months, for diseases other than those of the respiratory tract Cultures were taken carefully from the nose and nasopharynx using platinum loops, and inoculation took place on blood agar plates

Twenty of the children had tonsils and adenoids removed previously, but they showed no significant difference in the nasopharyngeal flora from the other patients

The nasal flora in this study contained chiefly non pathogenic microorganisms in small numbers *Staph Albus B* was present most frequently Many of the cultures from the normal noses were sterile The only potential pathogen found with regularity in the nasal secretions was *Staph Aureus A* On the other hand potential pathogens may be present in the nasopharynx of normal children The most frequent one here was *Str Viridans* There were no sterile cultures in this group

For comparison, cultures from 50 patients with nasal infections were examined These patients were from private practice and out-patient departments They revealed mainly pathogens on culture and were found in appreciable numbers The most common organisms were *Pneumococcus* and *Staph Aureus A* also, there was a fairly large number of *H Parainfluenzae* The series showed that the *Strep Hemolyticus* is not present in upper respiratory infections or the normal nasopharynx as frequently as is usually thought.

Asked if there were any vaccines now available that are effective in preventing or alleviating the common cold the British Medical Journal[7] replied as follows

'No, there are no effective vaccines as far as the common cold infection itself is concerned Antibacterial vaccines may be of value against secondary infections, but there is no good justification for using them in a widespread manner No new work has indicated lines on which a successful vaccine is likely to be developed soon There is no scientific basis for using oral vaccines against colds"

McKee[8] made some interesting observations on the bacteriology and virology of acute infections of the upper respiratory tract

First, microbes exist as populations when the mixture is not only of different species but of different genera as well The ratio of one species or genus to another may be important.

Second, certain factors may promote a disparity among the total population Factors such as diet, pH, and natural microbial antagonism and immunity are mentioned Antibiotics are frequently the cause of such upsets in the microbial population For instance *Hemophilus Influenzae* was a relatively uncommon component of the normal oral cavity before the use of penicillin allowed it to be cultured in high incidence

Third, it is now likely that there are similar interrelationships between bacteria and viruses and between viruses and viruses

Some bacteria adapt readily to therapy or other would-be adverse situations Since microbial growth rates are so great the uncommon organism today may thus become the prevalent organism tomorrow

Many changes in bacteria are dynamic and not at all permanent, so that the ebb and flow of changing circumstances suggest an equilibrium propensity on the part of the microbe For instance staphylococci may increase from, say, 10 per cent to 60 per cent resistant while on antibiotic Then if the antibiotic is stopped, this may drop to 40 per cent and then go up to 60 per cent when the drug is started again

Viruses are a considerably more difficult group to study, but some of their genetic potentialities have been studied and have provided interesting material for speculation This work is very complex and not possible to summarize except to note that the studies concern the virus reproductive cycle, the antigenesis of viruses, immunity and carrier states

This is a very thoughtful paper and should be read in its entirety

DRUGS

Stark[9] compared hexylcaine with cocaine by animal tests for toxicity and clinical tests for potency, the latter by applying the solutions to the nasal mucosa, observing as well the efficacy of hexylcaine as a topical anesthetic for endoscopic examinations

Further observations were made regarding the hydrolysis of the drug in human serum.

His conclusions were that hexylcaine appears to be as efficient a local anesthetic as cocaine for endoscopic procedures and appears to have a greater margin of safety

King[10] reported a case of an allergic infant seven weeks old, in whom the use of vasoconstrictor nose drops was effective in providing temporary airway, but the ' rebound" swelling was so great that the nasal airway was almost completely non-existent

Because infants have a very strong tendency to breathe through the nose this child would become so cyanotic after repeated attempts to get air through its nose that tracheotomy was seriously considered

The case was successfully handled by treating one nostril only with vasoconstrictor drops. The untreated nostril recovered spontaneously in 12 hours after "withdrawal" of the nose drops, then the vasoconstrictor was discontinued completely

King[11] presented a series of 176 from 2 to 11 years of age upon whom adenotonsillectomy was performed To each of 85 cases 5 mgm of vitamin K was administered orally three times daily for one week prior to operation The remaining group of 91 cases received none.

At operation the amount of blood loss was carefully measured The computed amount of blood lost averaged 52 cc. and this was not significantly affected by the oral pre-operative administration of vitamin K

Silcox[12] studied the effects of intranasal hydrocortisone alcohol

The search for another steroid which might be as effective as cortisone and ACTH was made, because these drugs had been shown to have many disadvantages among which were the objectionable complications from the doses required, and the fact that not being readily soluble in water they were difficult to prepare for topical use

Hydrocortisone has proved to be the most promising of the newer steroids, and the alcohol is the most valuable form

The studies showed that topical hydrocortisone alcohol can exert a beneficial effect on the allergic nasal membrane even in extremely dilute concentrations In cases of allergic rhinitis with polyps the effect was often dramatic but sometimes temporary The solution was of no value in acute rhinitis

The addition of vasoconstrictor components and antibiotics (Gramacidin, Neomycin and Polymixin) produced a solution which was just as effective as before with the straight allergies, but which was also useful in cases with bacterial infection

McKendry, Schwarz and Hall,[13] believing that a suitably prepared and formulated ACTH preparation can be effectively absorbed through the nasal mucosa, proved its effectiveness in nine normal individuals They demonstrated a satisfactory decrease in circulating eosinophils and an increase in urinary 17-ketosteroids following a single dose of 40 I U intranasal corticotropin

Following this demonstration they made therapeutic trials on seventeen consecutive patients with conditions known to respond to ACTH or cortisone In 14 of the 17 patients definite clinical improvement was observed Two of the improved patients were children

Case 1 L S a three-year old boy had nephrosis for 16 months He had had excellent results following treatment with intramuscular ACTH on three separate occasions When severe edema again necessitated treatment intranasal ACTH, 40 I U was administered by insufflation twice daily for eight days Two days after profuse diuresis began and body weight dropped form 48 pounds to 38½ pounds When discharged from hospital on the fourteenth day the weight was 31 pounds The clearing of edema which followed intranasal ACTH was at least as complete as that previously obtained from parenteral ACTH

Case 8 L Y a boy aged 16 with severe chorea of five days duration and with a previous history of Sydenham s chorea successfully treated with *Cortisone* was given intranasal ACTH 40 units three times a day for one day 40 units twice a day for two days and 40 units daily for one week. On the third day the choreiform movements were considerably diminished in frequency and in force and on the sixth day the only remaining sign was a slight tremor of the tongue On the seventh day the intranasal ACTH was discontinued with no recurrence of choreiform movements.

The writers state that improvement was satisfactorily maintained as long as the patients continued to take adequate doses of the intranasally administered hormone No untoward manifestations were observed apart from slight nasal irritation and occasional sneezing in the first few minutes after taking intranasal corticotropin

ANTIBIOTICS

The effect of antibiotics on the nasopharyngeal flora of premature infants is discussed by Marie Stoppelman[14] of Boston The infants in her study came from two nurseries the Infants Hospital and Boston Lying in Hospital The former received admissions to its nursery from other hospitals and homes, and the latter received the infants immediately into its own premature nursery

Past experience had shown that the routine administration of antibiotics had brought about a substantial reduction in mortality The number of premature infants studied culturally was 143 and of these, 51 were given antibiotics as follows eight received Oxytetracycline (Terramycin) 29 combined Penicillin and Streptomycin, and 14 combined Penicillin and Sulfadiazine

Nasopharyngeal cultures were made on the first, third, fifth and tenth day after birth In spite of the origins of the two different groups studied, there was no significant difference in the nasopharyngeal flora. Seventy per cent of all cultures obtained on the first day were sterile. The predominating organism on the third day and thereafter was pyogenic staphylococci, with alpha hemolytic and anhemolytic streptococci, gram negative organisms (largely E Coli) appeared next in frequency The occasional presence of other organisms was noted One significant characteristic found in the nasopharyngeal flora of the treated infants was the reduction in the presence of streptococci however, the emergence of pure culture of pyogenic staphylococci was noted in those infants treated with antibiotics

Schwarzer and his associates[15] studied the effect of tetracycline on infants and children from the clinical point of view They carried out this work in order to determine

1 The rapidity of absorption from the gastro-intestinal tract

2 The duration of serum levels after single and multiple oral doses.

3 The diffusibility into the cerebrospinal fluid

4 The urinary excretion

5 The tolerance

6 The therapeutic effect

7 The establishment of a rational dosage schedule for children

The drug was administered orally in the form of chocolate suspension in a concentration of 50 mg per cubic centimeter Forty-four children ranging from the ages of one month to thirteen years participated in this study They were all hospitalized patients and were convalescing from various diseases The final results showed that Tetracycline is absorbed rapidly into the blood stream after oral administration, therapeutic serum levels of eight hours' duration were produced with a single dose of 6 mg per kilogram Further increase of dosage gave a proportional increase of serum concentration Tetracycline diffused poorly into the cerebrospinal fluid without meningeal inflammation It is excreted in high concentrations in the urine, and the patients showed a high tolerance to the drug A remarkable lack of side reactions was observed The studies indicated that the effective oral dose of Tetracycline is 25 mg per kilogram per day given at six to eight hour intervals

CONGENITAL ABNORMALITIES

Beinfeld[16] gives an interesting account of a case of bilateral choanal atresia in a one-month premature infant. He points out that this condition is an important cause of asphyxia of the newborn His case was kept alive at birth by means of a metal airway in the mouth This airway was kept in for 17 days, during which time attempts were made to correct the choanal atresia The bony obstruction on the left side was perforated by a No 2 Lempert type mastoid curette on the second day of life. A catheter was passed through the nasal opening into the pharynx and left in place On the next day an attempt was made to perforate the right side but no air could be felt coming through this side after what had seemed a successful attempt with the curette. During this time the baby was fed by a gavage tube passed through the mouth The nasal tube soon blocked off, and no air could be felt coming through

On the seventeenth day of life the left posterior naris was again perforated and a larger tube put in There was now good breathing, and the airway was removed from the mouth The baby took the bottle for the first time The tube in the nose was taken out the next day and was left out, as there was a good airway

Seventeen days later the breathing became bad enough to require the airway in the mouth again It was obvious that the opening into the nose had closed The same procedure as previously used was carried out and a tube inserted, establishing once again a good airway The other side of the nose was freed at this time and tubes inserted into both sides Eventually, after some minor difficulties, the openings were established on a permanent basis by inserting the tubes at night and leaving them out during the day At about five months of age the tubes were replaced every third night, and the treatment progressed to the point where the tubes were left out for a month, and replaced once to ensure a permanent opening

Walker[17] reports successfully correcting congenital bilateral choanal atresia in a two-month-old female child He used the transpalatine surgical technique outlined by Ruddy and followed the case for two years

His conclusions are the diagnosis of congenital bilateral choanal atresia is made easily and may be suspected in an infant with recurrent cyanosis, feeding difficulty mouth breathing and nasal discharge It is probable that some infants who have died with the diagnosis of asphyxia neonatorum were in reality victims of complete nasal atresia A few patients have been known to survive

Surgical relief of the obstruction is imperative Postponement of surgery until the patient can tolerate the condition is risky and undesirable The transpalatal approach is feasible in the young infant, offers surgery under direct vision and does not require special instruments

One authority had concluded that closure of the palatal wound was unnecessary, because the palatal flap was always sloughed in patients under six months of age In this case, however, healing occurred by primary intention and, therefore, it seemed advantageous to close the incision The astute physician caring for the newborn will uncover more cases in the future The surgeon has an excellent opportunity to improve the survival rate No previous experience is necessary to handle a case properly

Everberg[18] reported a case of abnormal course of the cervical part of the internal carotid artery

It is important to be aware of this anomaly It is a congenital aberration and, therefore, may be present in young patients who are subjected to operations on the pharynx such as tonsillectomy and adenoidectomy or incision of peritonsillar or retropharyngeal abscesses

An abnormal course of the artery may be present to a varying degree and may disclose itself as a faint pulsation of the posterior palatine arch or a prominent pulsating vessel deep to the posterior pharyngeal wall

ALLERGY

Allergy and infection in rhinitis are discussed by Pepys[19] He says that they may be associated in three ways

1 Allergy complicated by infection,

2 Infection predisposing to the onset of the allergic condition,

3 Infection leading to the development of "bacterial allergy"

The complication of allergy by infection is common, due to the disturbed nasal physiology caused by the swollen allergic mucosa Control of the underlying allergic condition is necessary if there is to be more than temporary improvement from the antibiotics and chemotherapeutic agents

The influence of infection as a predisposing cause for allergic respiratory disease may be due to a lowering of the clinical threshold, thus making manifest a previously subclinical allergic state The role of bacterial allergy as a cause of typical allergic rhinitis is not generally accepted It has not been adequately proven, although it is often suspected on the basis of negative evidence because of the failure to identify the causal allergen

Allergic rhinitis may appear at a very early age, and the clinical history is most important at all ages One form is the repeated so-called "colds" These are not accompanied by the sore throat and malaise of the usual infective cold, but are associated with sneezing and rhinorrhea They may be of short duration and nasal itching is common. Another form of allergic rhinitis is that of the continuously blocked "stuffy nose" This is often aggravated in the morning, and persists for prolonged periods after infective, or what appear to be infective, colds

The history of allergic disorders in the family, infantile eczema, asthma, gastro-intestinal disorders all support the diagnosis of allergy The nasal mucosa is pale, swollen and boggy, though associated infection may alter this for a time Cytological examination of the nasal discharge can be helpful since the presence of eosinophiles supports the diagnosis of allergy Further evidence may be obtained from trials with therapeutic agents such as ephedrine or anti-histaminic drugs by mouth. Relief of the nasal obstruction indicates that this is due to swelling of the nasal mucosa rather than physical bulk of adenoid tissue

The remainder of this paper is taken up with the investigation and treatment of the allergic state of the child This includes the usual investigation of various foods and inhalant allergens Skin testing is of limited use in infancy but has its value later on. Control of environmental inhalant allergens may be supplemented by injections of the appropriate extract. Anti-histamine drugs by mouth are most useful, but their prolonged use may lead to loss of appetite, general depression and undue sedation. Local vasoconstrictors for nasal application should be used with care, since potent vasoconstrictors may produce a "rebound" vaso-dilatation.

To obtain results there must be an adequate follow-up and a concerted appraisal by pediatrician, ear, nose and throat surgeon and general practitioner.

TONSILS AND ADENOIDS

Rendell[20] states that under ideal conditions pre-operative sedation for children undergoing tonsillectomy would perhaps not be necessary; however, the importance of avoiding psychic trauma has long been realized. The practice of holding a crying, frightened child and compelling him to undergo something which he instinctively dreads often leaves an ineffaceable memory that quite naturally results in an intense hatred of doctors, nurses and hospitals. On the other hand, ill-chosen premedication may cause depression of the cough reflex and perhaps allow aspiration of blood or vomit.

Barbiturates combined with atropine were in routine use in her hospital. The children fell asleep in bed and knew nothing of their visit to the theater. No difficulty was experienced through depression of the cough reflex. A disadvantage was that nearly all showed marked post-operative restlessness and, to insure their not injuring themselves, needed more nursing attention than was conveniently available. Post-operative "nepenthe" helped the children to settle; however, the giving of central depressants both before and after operation might well have been criticized had accident occurred.

It was decided to observe the effect of methylpentynol on a series of children for tonsillectomy.

Methylpentynol (oblivion) and atropine were given to 152 children for pre-anesthetic medication before tonsillectomy. It successfully diminished pre-operative apprehension in 130 cases and in 17 it was partially successful. Only in five was it a failure.

The drug was readily acceptable to patients, and toxic or unpleasant side-effects were not observed in this series Protective reflexes were not depressed and post-operative restlessness was but slight The difficulties of nursing care were consequently reduced Evidence on amnesia was incomplete, but the impression was gained that it did not occur to any marked extent

Methylpentynol fell short of the ideal in the following ways most children were not asleep amnesia did not occur and therefore, the patients were conscious of and remembered the induction which they did not like Also they saw what went on in the ward Of the 152 children, 22 were unhappy Vomiting was not unusual during the induction After operation there was need of sedation as often as after barbiturate pre medication, *so that methylpentynol, like barbiturates appeared to* be without analgesic properties

Jongkees[11] in a paper on the psychic effect of hospitalization and surgical interventions on children makes the point that the operation for tonsillectomy is bound to have some psychical influence on the child

The age of the child and his intellect are undoubtedly of great importance. If the child can be reasoned with quietly and the whole operation and its after effects explained to his satisfaction, the chances are that no bad psychical after effects will occur, but most children can not be so readily psychologically prepared, and it is necessary to make the circumstances as favorable as possible so that the psychical influence will not be disastrous

If at all possible the child should be convinced of the necessity for the operation, and be given an explanation of the good results that may be expected before being sent to hospital He should be told that he will stay alone in hospital without his parents He should be told about the operating room and the anesthetic, and above all he should be warned that his throat will hurt, and that some blood may come out of his nose or mouth

At hospital the child's questions should be answered as truthfully as possible and he should not be taken by surprise

On the other hand his protests should be quietly but firmly rejected

Post-operatively fluids of a reddish color are a big advantage in that if some of the fluid drains back into the glass from the child's mouth, any blood which may have become mixed with it is not noticeable The coloring of water or milk with blood from the mouth is often a cause of much distress and anxiety

The stay in hospital should not be prolonged after 24 hours unless really necessary

This is an interesting paper well worth reading in its entirety

Out of the morass of speculation concerning the tonsil and adenoid question, Badger[22] states there are a few specific matters to be considered from the viewpoint of the internist

First, what are the indications for removal of the tonsils and adenoids? He finds the best answer one made by Lyman Richards "The best results of tonsillectomy are obtained where the symptoms have been clearly referable to the tonsils and associated lymphoid tissue" Conversely, he observes that the further complaints are from the tonsils, the poorer the results are with their removal

Second, the hazards of tonsillectomy should be no contraindication for surgery when the need is clearly present Nevertheless the hazards are worth serious thought To the internist various accidents associated with tonsillectomy are cause for concern when the procedure is considered so trival and when it is used for treatment for reasons that are not always too clear It is also only fair to admit that the reports from our medical centers of the hazards of tonsillectomy are of the best results that can be obtained in skilled hands, and that the true incidence of deaths and complications in rural areas can never be determined accurately

As a result of searching the literature he found only three factual and original studies between 1922 and 1952 with information on the hazards of tonsillectomy

The internist looks with great skepticism upon the benefits of tonsillectomy in the prevention of respiratory infections except when breathing is interfered with by overgrowth of lymphatic tissue, or when repeated bacterial infections localize in the tonsils or in the tonsillar glands

In current studies of the common cold and other viral infections "sore threats" are falling more and more into the group of viral infections, and tonsils and adenoids, present or absent, do not appear to play much part in their course or incidence, furthermore the general and less tangible factor of individual resistance and susceptibility to respiratory disease is all too generally disregarded

The internist believes that poliomyelitis is only one of the neurotropic diseases in which the trauma of tonsillectomy and adenoidectomy should be avoided in epidemics Encephalitis of any type, influenza of proved type, as well as epidemics of meningococcus meningitis should be signals for the avoidance of any unnecessary surgery on the respiratory or alimentary tracts The removal of tonsils and adenoids lays bare a large surface of nasopharyngeal tissue where these viruses and organisms are found

The human body appears to abhor the removal of tonsils and lymphoid tissue of the nasopharynx, at least before the tonsils have stopped growing This fact is evidenced by the amount of lymphoid tissue that grows back after the larger tonsils and adenoids have been supposedly cleaned out surgically

The physician should not regard the removal of these organs as a trivial procedure Rather it is one requiring great skill in anesthesia, in operative technique and in post-operative care in addition to careful selection based on the needs of the patient rather than the accessibility of the organ itself It is indeed clear that the internist and the family doctor cannot escape their share of the responsibility with the otolaryngologist in decisions regarding the need and the wisdom of removal of the tonsils and adenoids

To Eley[11] it has always seemed poor practice of medicine to refer a patient to an otolaryngologist without first contacting him and explaining why his opinion is desired or why tonsillectomy and/or adenoidectomy are necessary The previous history of the patient and the possible underlying hazaids are really known only to the pediatrician (the family physician to children), and without this information the otolaryngologist may be at a complete loss as to why the patient was referred The relationship between the two physicians should be on a consulting basis, and only after such an understanding has been established can the question be solved

The physician is familiar with tonsils that are so large that they force the uvula into the background and, too, there is the adenoid tissue that produces a deep bass sound during sleep These local conditions, especially those involving the adenoid structures, may, and do, cause serious complications in infants and children

To him there is no greater or more serious problem than that of possible impairment of hearing *How often the physician is faced with the question of whether the child is mentally retarded or actually handicapped by impairment in hearing, hence appearing retarded* The need of office and hospital services for persons trained in the art of detecting early changes in hearing ability is one of the most important questions faced today

The theme of the relationship of mastoiditis to chronically infected adenoid tissue is seen less often since the introduction of antibiotics and chemotherapy Such agents, however, have had little, if any, influence on mouth breathing, the development of the so-called adenoid facies, inability to sleep because of impaired breathing space, and numerous other disturbances readily attributable to such chronic infections In these conditions the answer is apparent, *i e*, the removal of the infected tissue and/or irradiation as necessary

He believes that under normal circumstances the dangers and hazards of tonsillectomy and adenoidectomy have been reduced to a minimum when directed and performed by competent physicians

His conclusion is that most pediatricians view the tonsil and adenoid question with respect, but they also view the general health of their patients with a greater respect, and in selected instances and under proper circumstances advocate the removal of these lymphoid threats

Hoople[24] states that now tonsillectomy and adenoidectomy is being performed to conserve hearing much more than in previous years

In the Northeast, at least, the winter season is the dread of most otologists This is the time of the year when the office is often filled with children who have inflammation or infection of their ears When it is the former, it is almost always accompanied by the collection of some sterile fluid in the ear, that is, otitis media with effusion

This condition frequently is more difficult to treat and eradicate than infection and neglect can result in partial, but permanent, loss of hearing Too often children with inflammation and fluid in their ears do not come to the otologist They remain in the office of the pediatrician, with the accompanying hearing loss undiagnosed or excused with the assumption that the child's lack of response to queries or commands is due to inattention and not to impairment of hearing, furthermore, the end result of antibiotic treatment for an ear infection may be a sterilization of the infectious process with a residual otitis media with effusion This is particularly true, in his experience, with penicillin therapy

The end result in such an instance is the same as though there were no infection in the first place but only inflammation With the subsidence of pain, temperature and discharge (if such were present), the pediatrician is apt to consider the patient cured, although this is far from the truth. Fortunately, some pediatricians are sharply aware of this problem but there are too many who do not concern themselves with moderate or slight hearing losses The otologist can do nothing but sound this note of warning

If then the otologist is confronted with a patient who has some of these ear problems it is his duty to advise a very thorough removal of the infected lymphoid tissue present. If infected tonsils are present, their removal should be included but the careful removal of the nasopharyngeal disease is the more important It does not matter what age the patient may be

He has removed adenoids from a child only three months old, and has seen infected adenoids in persons who are in their sixties The time factor is important Removal should be undertaken as soon as the local condition in the nasopharynx warrants surgery Waiting for summer is often unwarranted, for the public has become so poliomyelitis conscious that one cannot operate during the summer and early fall months

A cogent reason why operation should be instituted as soon as possible is that another episode may be just around the corner, and this episode may be the one that will really cripple the hearing in one or both ears Each attack is potentially a serious one Every attack probably lays the groundwork for some loss of hearing, but one never knows which attack may leave a striking aftermath

He advocates adenoidectomy under vision and for this prefers a Lothrop retractor and a triangular forceps with a basket attachment

Secondary adenoidectomy he considers more difficult than the original adenoidectomy Infected lymphoid tissue bound down by scar tissue is often present No curette and no adenotome will remove this It must be cut away with a proper biting forceps, and this must be continued until all lymphoid tissue is removed A secondary adenoidectomy often takes longer to perform satisfactorily than the primary one

One comforting thought to the operator who follows this technique is that he will have less post-operative bleeding from the nasopharynx Most nasopharyngeal bleeding comes from incompletely removed lymphoid tissue

He failed to obtain satisfactory results from the use of the radium applicator Since he has paid more attention to the complete adenoidectomy, his surgical results, the decrease in the incidence of ear infections and the improvement in hearing in these patients have been gratifying

Boies[25] states that surgery of the tonsil, discussed for nearly 3,000 years, is still controversial, probably first because the indications for its surgical treatment are often based on superficial observation, and second, because there is a morbidity and even mortality associated with it, since it is attempted by many who have not acquired skill through training and experience in working in this area

Tonsillectomy and adenoidectomy is justified in cases of repeated attacks of tonsillitis or adenoid infection hypertrophy to the extent of obstruction, and when there is evidence of persistent chronic tonsillar or adenoid infection A clean tonsillar fossa with the minimum of trauma to the pillars and muscular bed and thorough hemostasis are the marks of a skillful, carefully performed tonsillectomy

A thoroughly performed adenoidectomy requires good exposure of the nasopharynx time, hemostasis and visualization of the end-result. The hazard of hemorrhage is minimal if care and thoroughness are used The anesthetic risks of periods of anoxia, uncontrolled aspiration of secretions into the lung and other anesthetic hazards are practically eliminated with the best modern intratracheal method

The hazard of increased susceptibility to bulbar poliomyelitis and of the greater possibility of death, if the disease is contracted, 'call for sober judgment with regard to the desirability of tonsil removal except for excellent clinical indications The non removal of tonsils may be as hazardous to a person or more so than their removal, for the chance of contracting poliomyelitis in a clinically recognizable form is not great"

In the Section of General Practice of the Royal Society of Medicine[24] a discussion was held on tonsils and adenoids

One speaker stated that the problem of enlarged tonsils and adenoids was mainly one of childhood Lymphoid tissue tends to regress after the age of 12 to 15 years After that age there is no problem of treatment. "When in doubt, take them out." They have served their purpose and can be dispensed with if there is reasonable evidence of their doing any harm.

He believed that the indications for the removal of adenoids were straightforward and the decision easy to make The indications were

1 Gross nasal obstruction producing constant mouth breathing and snoring when asleep, even when there was no coryza present

2 Recurrent attacks of otitis media with or without otorrhea

The problem of how best to deal with diseased tonsils was more difficult Probably all practitioners had their own ideas of what a chronically infected tonsil looked like, but it was extremely difficult to prove the infection and its chronicity The following he considered definite indications for the removal of tonsils in children

1 Frequent attacks of tonsillitis with persistently apparent infection in the tonsils between attacks and persistently enlarged and tender lymph nodes

2 After two and possibly after one quinsy

3 When the tonsils are so large as to cause obstruction of respiration

4 Diphtheria carriers

Another speaker added three diagnostic points to the above indications for adenoidectomy The first was that chronic sinus infection was commonly linked with enlarged adenoids The second was that a child who was sick in the early mornings before breakfast, with a slimy vomit, had probably been swallowing mucopus all night and needed attention to the adenoids, but neither of these associations was invariable and absolute The third was a diagnostic warning The child brought with a history of frequent absence from school because of colds, of much early morning sneezing, and of vigorous nose-blowing with very little result, was suffering from allergic rhinitis, for which operation on tonsils and adenoids was useless

He advised caution regarding tonsillectomy He stated that a child who failed to thrive, or lost its appetite, might benefit from tonsillectomy The operation was valuable in the treatment of tuberculous glands of the neck, because the tonsil was usually the portal of entry of the tuberculosis Tonsillectomy should be done whenever tonsillar disease impaired the child's health, no matter what his age

A third speaker pointed out that it was physically impossible to remove adenoids completely When the tonsils were completely removed, particularly in the first five years of life, lymphoid tissue around the pharynx tended to hypertrophy as a substitute for regeneration This tendency was a further reason for conservation rather than operation

Johnston and Watkins[27] claim that during the past 30 years there has been an increased conservatism in the decision to remove tonsils and adenoids, but they feel that the pendulum has swung too far to the conservative side The authors' appraisal of results following the removal of tonsils and adenoids in 598 children was arrived at by

1 Replies from parents as to their opinion on the effect of the removal on specific complaints

2 By rechecking several groups of patients with conditions thought to be influenced by chronic infection

3 By a small series of metabolic studies before and after the procedure Of the 598 children, 112 were between the ages of one and four years 331 between the ages of five and seven and 155 between the ages eight and fourteen

Improvement was noted in 71 per cent of ear infections, 89 per cent of the cases with abdominal pain referable to chronic infection were improved Out of 87 patients of all age groups with bronchitis 74 showed improvement Of those patients with sinus infection only 18 out of 28 were benefited by the operation

The results of tonsillectomy on patients with asthma were unsatisfactory as only three out of 22 asthmatics showed any improvement. Children with anorexia showed an improvement in 84 per cent. Impaired hearing was benefited in seven out of nine patients, and eight of ten cases with infectious arthritis were improved

The metabolic studies showed nitrogen retention was better in nine children One child followed for 18 days before and

27 days after operation, showed a three-fold increase in the storage of both nitrogen and calcium

As a result of these findings the authors conclude that tonsillectomy and adenoidectomy remains a highly beneficial procedure in the properly selected cases

Works[28] discussed the complications of tonsillectomy, and reported on the experience of the Ross-Loos Medical group with more than 28,0000 tonsillectomies

He feels that adenotonsillectomy should be considered a major surgical procedure and stressed the need for positive indications for surgery

The locations of tonsils makes surgery on them risky Among the complications that can occur are aspiration, spread of infection into the neck, and hemorrhage The tonsils are in a vascular area and are also in a muscular mobile area which tends to dislodge clots and ligatures, and to release thrombi, furthermore, the fact that blood can be swallowed may conceal hemorrhage

The number of complications in this series was small, likely due to careful pre-operative work-up, insistence on highly trained surgeons, and anesthetists plus recovery rooms with close supervision and facilities to handle any emergency that might arise

The paper includes useful information on the management of complications if and when they do arise

Meltzer[29] concludes an admirable paper on the technique of removal of adenoid tissue of the nasopharynx in children by saying that the technique described has given him great satisfaction when used for children in whom tubal closure with hearing loss was a recurring problem Regardless of the specific purpose for which this technique can be applied, it is high time for otolaryngologists to show the correct way to perform an adenoidectomy, thereby saving countless numbers of children from the miseries of recurrence

Adenoidectomy is generally considered to be a minor surgical *procedure of little consequence* The technique used may be deplorable, yet the results may be amazingly good For this paradox, nature is to be thanked The natural process of recession accounts for the excellent results we see

The record is not so good in patients presenting a complicated problem, such as sinusitis or otitis, or in patients in whom re-growth and hypertrophy develop after removal of the original obstructing tissue Remnants of tissue left behind in the fossa of Rosenmuller, or on the Eustachian tube—such tags of tissue can and do undergo edema from infection causing recurrent tubal closure, with subsequent secretory or suppurative otitis media and ultimate hearing loss

A great step forward toward visualizing the surgical area was made when Yankauer introduced the tubular speculum, and it remained for Lothrop to provide a retractor that made it possible to visualize the nasopharynx and the structures in it.

The anatomic details of the postnasal space and the variations cannot be appreciated and taken fully into account unless the palate is elevated and the area actually inspected

Only experience will perfect one in the art of elevating the palate properly To expose the torus, the retractor is placed laterally on the palate just above the tonsillar fossa and the wrist flexed Slipping the lip of the retractor behind the torus and again flexing the wrist will beautifully expose the fossa of Rosenmuller

To visualize the postnasal space in some cases requires extreme pressure on the palate. The ease with which the entire postnasal space can usually be exposed to view makes it inexcusable for the otolaryngologist to carry out adenoidectomy in any but the careful and thorough manner possible only under direct visual control Once the main mass of adenoid tissue is inspected it can be removed by several insertions of a sharp-bladed LaForce adenotome of suitable size

Next one inspects the Eustachian tube, the lateral bands (salpingopharyngeal folds) and the fossa of Rosenmuller The surgeon who has never performed any but "blind" adenoidectomies has a surprise in store for him A direct view of the anatomy of this region will make it clear to him at once why neither curette nor LaForce adenotome alone can remove lymphoid tissue from this area

He will find that the fossa of Rosenmuller varies widely in depth and in width Sometimes the fossa is so deep that one cannot see the cutting edges of the instrument, no matter what retractor one uses One learns to tell by the feel of the instrument when the recess has been cleaned of lymphoid tissue In this area he uses a No 1 ring punch, with a gentle curved sweeping motion of the instrument, opening and closing it repeatedly along the superior margin of the posterior nares as it blends with the upper portion of the fossa of Rosenmuller

In the relatively few cases in which the surgeon cannot see the head of his cutting instrument he may have to palpate this particular area for small tags He utterly condemns as non-surgical the maceration of adenoid tabs by friction with a gauze-wrapped finger To remove the lateral bands lying along the posterior pillar of the tonsil extending upward to the tube, he gently rolls the pillar laterally The hypertrophied band of lymphoid tissue is then trimmed to the desired depth He disapproves of sharp dissection or stripping of this tissue Lymphoid nodules on the posterior wall are removed with the small oval punch, cutting with the pharyngeal surface Deep bites may produce unnecessary scarring

Even under direct visual control islands of lymphoid tissue will remain in the mucosa that may subsequently hypertrophy

The removal of recurrent adenoid growth makes greater demands on the surgeon's skill than a first operation Because of bleeding, second removal is a time-consuming procedure that calls for great care and patience He places sponges in the nasopharynx to control bleeding and also uses curved hemostats to clamp the vessels

As a final precaution he paints the entire surface of the post-nasal space with Garland's solution (tincture guiac 25 cc, tincture iodine 25 cc, and tincture benzoin compound 200 cc)

Fisher[30] has discovered that post-nasal adhesions are a common occurrence and, believing that this fact is not generally known, he desires to attract recognition of its importance as a factor in diseases of the ear, nose and throat

He states that it cannot be doubted that the conditions of the lateral pharyngeal recess are ideal for the implantation, harborage and establishment of pathogenic infection, and that the clinical findings so commonly met with, i e presence of adhesions binding the walls of the lateral recess are surely proof of previous or persisting inflammation

The author breaks these adhesions with his right index finger with the patient lying recumbent With high strung and hysterical individuals and children, a brief and light anesthesia is required The performance is followed morning and night by a gravitation bland saline nasal irrigation

He devotes a paragraph to the clinical manifestations and gives brief descriptions of four patients who were relieved by finger manipulation

Comment The condition of the nasopharynx is best discovered by nasopharyngoscope Although rupture of the adhesions has frequently benefited the patients, the writers have often seen adhesions which were not causing the patient any disability The condition has long been recognized in America and has on occasion led to sporadic waves of spurious treatment.

Reeves and Brill[31] reviewed the anatomy and histology of Rosenmuller's fossa, the tubal orifice and the folds around the tubal orifice in 622 visually controlled adenoidectomies There are three folds around the tubal ostium which if enlarged may interfere with the free movement of air to the middle ear

The salpingopalatine fold accentuates the anterior lip of the tube and is reinforced by a ligament. This plica varies in thickness according to the number of glands and lymph follicles in the mucosa covering it

The salpingonasal fold arises from the ostium and is directed upwards towards the roof of the choana It may be separate from or be a continuous plica with the salpingopalatine fold

The plica salpingopharyngea arises from the posterior lip of the orifice and continues downward behind the posterior pillar

Histologically these folds are similar to the pharyngeal tonsil at its inferior border

These plica are best observed with a laryngeal mirror after the soft palate has been retracted with a catheter

If they are wider than 5 mm the writers remove them with Meltzer punches

In the Section of Laryngology of the Royal Society of Medicine[32] a very long discussion was held on the management of hemorrhage following tonsillectomy Almost every aspect of this subject was covered in a well-planned survey Reference to any question is easily found The reader is referred to the original

Comment Some text books current on this continent give advice regarding this complication which appeals to your authors as both shorter and sounder

The Lancet[33] commented on certain parts of this discussion

Ashcroft had heard within the past few weeks of no fewer than six deaths from this cause Hemorrhage after tonsillectomy was terrifying to the patient It might be equally alarming to a doctor inexperienced in dealing with it More skill was needed to control hemorrhage than to do the tonsillectomy Successful treatment depended on an understanding of the causes

He mentioned many undesirable preoperative factors, the significance of which should be discussed fully with a competent physician before tonsillectomy Skill and care in doing tonsillectomy could certainly reduce the incidence of postoperative hemorrhage The tonsillar fossae must be dry before the patient left the theatre On completion of the operation, all blood clot should be removed from the nose and nasopharynx as well as from the tonsillar fossae The patient should be placed on his side and the tongue prevented from falling backwards

One might expect slight oozing for the first hour after operation, but if, after this, there was still bleeding or if freshly swallowed blood were vomited, the case should be treated as one of reactionary hemorrhage If certain minor methods such as pressure, and removal of blood clot, failed to stop the bleeding, the patient should be returned to the theatre without delay Bleeding points should be identified and ligatured

True secondary hemorrhage, associated with damage to the muscular tissues of the tonsil bed, occurring any time between the third and fourteenth day, and accompanied often by a raised temperature due to the local inflammation, was fortunately less common Since the infected tissues were friable, simple ligature was often difficult

Mr S Mawson felt that apart from stopping the bleeding the replacement of blood volume was the vital factor in saving life in the reactionary period The volume of blood that could be safely lost without replacement depended on the age of the patient it should not exceed one tenth of his total blood volume Replacement was essential if the blood loss reached three-tenths of the total volume

Comment The chief speaker stated that suturing of the faucial pillars over a gauze swab was sometimes necessary in cases of true secondary hemorrhage where the infected tissues were friable This method for obvious reasons is condemned in good otolaryngological teaching on this continent.

Cummings[14] discussed the mortalities and morbidities following 20,000 tonsil and adenoidectomies performed in a 30 year period by general practitioners and otolaryngologists

There were nine deaths, four from hemorrhage, three from cardiac arrest and two anesthetic deaths, also, there were seven lung abscesses three foreign bodies plus a number of minor morbidities

From a study of this series he made the following observations and recommendations Internes on rotating services should be taught to perform tonsil and adenoidectomies and that residents in otolaryngology should spend at least three months in the department of anesthesia. Drop ether is the safest anesthetic for this operation Solutions of cocaine in the operating room should be colored and should be in charge of the department of anesthesia

He also felt that all patients who bleed postoperatively should have a hemoglobin determination and a transfusion if their hemoglobin is below 60 per cent. The head low position should be used for operation and the patient should be kept in the operating room until he has reacted Then he should be accompanied to the ward or recovery room by the anesthetist

Close postoperative watch should be kept by the nursing staff He felt that intratracheal anesthesia should be limited to adults because of the danger of postoperative laryngeal edema in children No preoperative sedation with depressant drugs should be used in children When cardiac arrest occurs the chest should be opened for cardiac massage Allergy *per se* is not a contraindication to tonsil and adenoidectomy Finally, that the possible relationship of poliomyelitis to tonsil and adenoidectomy be further studied

Emerson[35] describes a technique by which after removing the tonsil he sutures the mucosa of the anterior pillar to the bed of the tonsil fossa and the posterior pillar By this he controls hemorrhage, eliminates dead space and covers the denuded surface to allow healing by primary intention

He has performed the operation on 215 patients whose ages ranged from 18 months to 60 years The operating time is about 20 minutes for children and 30 minutes for adult patients

The healing time in children is five to seven days Adult patients have returned to work on the seventh to tenth postoperative day without difficulty There have been no serious complications, hemorrhage has not occurred, infection has not been a problem, although 300,000 units of procaine penicillin is used routinely on the day of operation and the following day, except in patients known to be sensitive to the antibiotics

IRRADIATION

Hardy and Bordley[36] reported on the five-year joint research project started in 1948 by the Johns Hopkins School of Hygiene and Public Health, the Department of Otolaryngology of the Johns Hopkins School of Medicine, the Department of Health and the Department of Education of the City of Baltimore

They report the following observations from a controlled study on the effect of nasopharyngeal irradiation in a group of school age children

1 There is unmistakable evidence that nasopharyngeal irradiation reduces lymphoid tissue to a remarkable degree

2 Both the treated group and the control group showed improved hearing The improvement was always more marked for the treated children whose hearing loss was a conductive type affecting all tones The improved hearing in the untreated children can be accounted for only by factors such as puberty, learning and improved nasopharyngeal hygiene

There was no evidence of trauma relatable to irradiation of the nasopharynx

3 The physiologic improvement in hearing takes place at puberty This may be associated with the change in the condition of the lymphoid tissue No other finding is so consistently relatable

4 The modern diagnostic methods are efficient in predicting hearing loss in school population

5 The success of this study was clear evidence of the feasibility and effectiveness of inter agency cooperation in a school health program.

Meltzer[37] is studying lymphoid tissue in the nasopharynx This tissue may be described as a mass of free cells, mainly lymphocytic, of various sizes, plus a supporting framework of reticulum cells and fibrous, elastic and sometimes muscular elements

The functions of lymphoid tissue has not yet been established Some believe that along with the tonsils it guards the gateway to the alimentary canal The defense theory further suggests *1* That lymphoid tissue filters undesirable material from the circulation, *2* That antibody formation takes place in the lymphocyte

To conciliate the barrier concept with the clinical experience that tonsils often become foci of infection and have to be removed, it has been suggested that these tissues, evolutionarily speaking, are a recent acquisition which is unequal to the assaults occasioned by exposure to crowded urban life.

Lymphoid tissue appears to be affected by allergy and in these patients there is a great tendency to recurrence even after the most thorough surgery

The endocrine factor promises to be an important avenue of research Adrenocortical secretion causes lymphoid tissue involution It may be that further experience with ACTH and Cortisone may indicate their use in nasopharyngeal lymphoid hyperplasia

At present the treatment varies from patient to patient, but may require surgical removal, irradiation or allergic management, or combinations of these three measures

TONSILS AND POLIOMYELITIS

Weinstein, Vogel and Weinstein[38] studied the records of 800 cases of poliomyelitis at a Boston Hospital to see whether tonsillectomized patients showed an increased susceptibility to bulbar poliomyelitis This work had been done before, but the authors were anxious to repeat the investigation to see whether it applied to patients observed by them

Of the 800 cases studied, 500 individuals had been subjected to tonsilloadenoidectomy at one time or another, and 300 had not been operated upon The types of poliomyelitis were listed as *a.* nonparalytic, *b* spinal paralytic, *c* bulbar, and *d* bulbospinal The case histories showed that the absence of the tonsils, even though they may have been removed many years before, was associated with a greater incidence of bulbar poliomyelitis In fact, all forms of poliomyelitis appeared to be more common in the tonsillectomized patients

The age group ran from six days to 56 years and there were 55 5 per cent males and 44 5 per cent females Age and sex were not important in conditioning the susceptibility of tonsillectomized patients to bulbar poliomyelitis They were unable to separate those who had had recent tonsillectomy from the other cases, so they were evaluated in terms similar to the general tonsillectomized patient

The authors showed that bulbar poliomyelitis was three to four times, and the bulbospinal type three to five times more common in tonsillectomized cases than in those who had not been operated upon, regardless of age The observations made in this study confirmed those of other investigators

The *Journal American Medical Association* commenting[39] editorially on the relation of absence of tonsils to poliomyelitis, states that data have been provided over a number of years to suggest that mere absence of tonsils and adenoids, regardless of the time of their removal, leads to increased susceptibility to poliomyelitis Three reports are summarized, the latest one being from Haynes Memorial Hospital, Boston in which 800 patients with poliomyelitis were studied

This study suggested that the absence of tonsils and adenoids, regardless of the time of their removal in relation to the time of onset of poliomyelitis, increased the risk that the bulbar form of the disease would develop Of 85 patients in whom bulbar poliomyelitis developed, 85 9 per cent had previously been subjected to tonsillectomy of those in whom tonsils were still present, bulbar poliomyelitis developed in only 14 1 per cent.

The incidence of both non-paralytic disease and spinal paralytic disease was higher in patients without tonsils than in those with tonsils Also the data presented by the authors appeared to suggest that the date of tonsillectomy when related to the onset of poliomyelitis may be of less significance than the mere fact that tonsils were absent.

Settlement of the latter aspect of the tonsil-poliomyelitis problem is of considerable importance to the entire medical world and merits further study, in view of the growing belief that recent tonsillectomy may lead to increased susceptibility to the bulbar and bulbospinal forms of poliomyelitis

The relation between tonsillectomy and poliomyelitis and between the presence or absence of tonsils and poliomyelitis, has been the subject of discussion for some years From time to time equally forceful, but in some respects conflicting, views have had ardent supporters, and even in the *Journal American Medical Association* different views on the subject have appeared within weeks of each other

A careful analysis of these and other published reports will show, however, certain basic agreements, even though there may not be a meeting of the minds on other points One of these beliefs about which there is less disagreement concerns the time interval between tonsillectomy and adenoidectomy and onset of the disease Most otolaryngologists seem to agree that if poliomyelitis strikes within a matter of days after such an operation there is a greater risk that the patient will have the bulbar type and more severe illness, and most of them also seem to have sufficient apprehension to recommend these operations only on a selective basis during epidemics of poliomyelitis

It is obvious that more study is needed on this important problem Some facts are now apparent, others still in question While a determination of the true relationship between some operations (or the effect on the loss of tissue by these operations) remains for further exploration before all of the questions are answered, one ancillary observation emerges Once again is there ample demonstration of the need for asking, "Is this operation really necessary?" before the tonsils or adenoids are removed

Juers[40] criticized the preceding editorial as follows "In the April 3, 1954, issue of the *Journal* there was an editorial entitled 'Relation of absence of Tonsils to Bulbar Poliomyelitis' It was based largely upon a statistical study by Weinstein, Vogel and Weinstein *(Journ Pediat*, *44* 14, Jan , 1954) These authors inferred that the absence of tonsils and adenoids increased susceptibility to the development of bulbar and bulbospinal poliomyelitis The validity of the statistical study is not questioned, but in this, as in many other recent similar reports, the conclusion reached is on somewhat fallacious grounds

"The fallacy is that the incidence and severity of a given disease are being compared in two biologically and immunologically dissimilar groups of persons In general this group not having had tonsillectomy has had better immunity to disease, especially in the upper respiratory area, and hence has not been subjected to tonsillectomy The second group, on the other hand, has been subjected to tonsillectomy because of poor immunity to disease, particularly in the cephalic area This poor immuno-logic response would undoubtedly also apply to invasion by the poliomyelitis virus

"It is my clinical impression that there is usually a greater degree of autonomic instability in the cephalic area in these persons before tonsillectomy, and that as a result the area may have become 'conditioned" to respond in an abnormal manner to many forms of stress, probably including that of poliomyelitis virus invasion

"The unanswered question still is whether the higher incidence of bulbar poliomyelitis in patients who have had tonsillectomy is the result of the absence of the tonsils and adenoids *per se*, or the result of pre-existing, greater local susceptibility to the poliomyelitis virus as compared to that of patients who have not had tonsillectomy"

Molenaar[31] comments about the editorial *(J.A.M.A* 1180 April, 1954), supporting the thesis that tonsillectomy increases the incidence of bulbar poliomyelitis which compares persons who have had presumably abnormal tonsils removed with persons who have had presumably normal tonsils left in "To avoid the obvious, that sick persons get sick more often than well persons, one should compare those who have had abnormal tonsils removed with those who have had abnormal tonsils left in"

Player[42] states that the data collected in the many surveys which have condemned tonsillectomy in the development of poliomyelitis do not lead to that conclusion The surveys have never really utilized a control group

He maintains that the surveys so far conducted have merely contrasted the incidence of bulbar poliomyelitis in patients with relatively more than average lymphoid disease (in whom the surgery is literally only an index of the severity) with the incidence in patients who have not had lymphoid disease sufficient to warrant operation In other words from the data collected so far there is even as much reason to conclude that if these severely involved patients had not had tonsillectomies done they might be even more susceptible to bulbar poliomyelitis or, stated otherwise surgery may well be protecting some patients from susceptibility

Anderson and Rondeau[43] state that foremost among the many unknowns in the pathogenesis of poliomyelitis are the factors that determine the type of the response to the infection There is ample evidence that infection with the poliomyelitis viruses is widespread, ultimately involving almost all persons except those in isolated areas In most of these persons the infection is mild, producing no paralysis and usually occurring without recognizable symptons Yet a small number of persons respond badly to the virus invasion, with resultant paralysis

In 1941 Top and Vaughan, reviewing 521 cases of poliomyelitis, had showed that 27 per cent of 215 persons who had had tonsillectomy at some time in their life had a bulbar involvement in contrast with only 4 2 per cent of 306 persons whose tonsils were *in situ* at the time of the attack Anderson and Rondeau, therefore, studied 2708 epidemiological histories gathered during the 1946 outbreak of poliomyelitis in Minnesota in an attempt to confirm the observations mentioned and to explore the causative factors

This paper is very long, provided with ten tables (errors in two of which were subsequently corrected), and bears the impression of exactitude, fairness and careful analysis It terminates with valuable comment to which the reader is recommended

Their summary and conclusions are as follows

"It has been found that persons with the bulbar type of poliomyelitis give a history of removal of the tonsils more frequently than do persons with other forms of poliomyelitis, and that, if clinically recognizable poliomyelitis develops in a person who has had his tonsils removed, the likelihood of bulbar involvement is four times as great as one whose tonsils are *in situ*

"This higher proportion of cases of bulbar involvement in patients who have had tonsillectomy occurs at all ages regardless of the time that has elapsed since operation This higher proportion in older persons is due primarily to absence of the tonsils rather than to age *per se*

"The higher proportion of bulbar involvement in recent years may be due to the greater frequency of tonsillectomy and the shift in age distribution of poliomyelitis to the ages at which tonsils may have been removed The lack of cases of bulbar involvement in certain areas may be due to the concentration of poliomyelitis in ages before tonsil removal The hypothesis that bulbar involvement is due to escape of the virus from the blood stream through the capillaries of the medullary area is not compatible with the greater incidence of such cases in persons who have had tonsillectomy

"It is possible however, that the excess of bulbar involvement in persons who have had tonsillectomy is due to direct invasion along fibers of the ninth and tenth cranial nerves No evidence was found as to the effect of tonsillectomy in altering susceptibility to clinically recognizable poliomyelitis The data presented deal only with likelihood of bulbar involvement if clinically recognizable poliomyelitis develops"

Robinson[44] believes that the statistics given in "Absence of the Tonsils as a Factor in the Development of Bulbar Poliomyelitis," by Anderson and Rondeau may be misleading or the interpretation of them may be Could it not be that the very conditions that caused the tonsils to be removed favor the bulbar type of poliomyelitis? If we accept the conclusion that removing tonsils favors the development of the bulbar type, many who need their tonsils removed may be deprived of the benefit.

A correspondent asked the *Journal American Medical Association*[45] two questions *1* Is there any objection to giving a patient the Salk polio vaccine one week after tonsillectomy? *2* Is tonsillectomy contraindicated within one to two weeks after the patient receives the Salk vaccine? He received the following reply

"There is substantial evidence of an increased risk of poliomyelitis especially bulbar during the immediate postoperative period following tonsillectomy This short-term risk has been documented only for patients operated upon during epidemics of the disease There is also evidence, however, of a relatively high incidence of bulbar poliomyelitis in persons subjected to tonsillectomy at longer intervals before onset of the disease No reason is evident why administration of the Salk vaccine following tonsillectomy should be expected to increase the risk of poliomyelitis

"The vaccine is treated with formaldehyde to inactivate the poliomyelitis virus, which is its essential constituent The tests employed to assure completeness of inactivation appear adequate to exclude any residual infectivity of the vaccine It is true that during epidemics of poliomyelitis some correlation has been found between the site of paralysis and the site of recent injections of various non-viral agents Conceivably an inactivated poliomyelitis vaccine, administered to someone already infected, might be capable of such a non-specific effect There is no evidence so far, however, that this is the case"

MacGregor[46] reports that a boy, age three, fell over while carrying a stick in his mouth, and the end of the stick forcibly enucleated his right tonsil Seventeen days later he became ill with what was proven to be poliomyelitis He made a stormy recovery

Hunter[47] describes an almost exactly similar case in a boy, age four Poliomyelitis developed seventeen days after he lacerated his right tonsil while falling with a stick in his mouth Recovery was slow due to persistence of facial weakness

MOUTH AND THROAT INFECTION

McMath and Pereira[48] make a case report on a 10-year-old girl who died from the rupture of an undiagnosed retro pharyngeal abscess

After an illness of a week this child was admitted to hospital exhibiting mild stridor, nasal speech, marked cervical adenitis and periadenitis in the anterior and posterior triangles The post-pharyngeal wall was inflamed and edematous with no evidence of abscess formation She swallowed fluids without difficulty

Eight hours after admission she suddenly became cyanosed and rigid, and stopped breathing Tracheotomy was at once performed and a tube inserted through which a large amount of thin brownish fluid exuded from the trachea She died immediately

Post-mortem examination showed an extensive abscess occupying the posterior pharyngeal region from the uvula and tonsillar region down to the arch of the aorta It had recently ruptured into the pharynx and flooded the trachea and bronchi

TUMORS

Gundrum, Stambuck and Gaines[49] had a newborn that presented the problem of obstruction to both nasal breathing and swallowing

They found that by raising the soft palate a grayish movable mass was exposed which lay against the posterior pharynx. No fluid was obtained by aspiration

The mass was pedunculated and was removed by tying the pedicle and cutting it with scissors

Histologically the mass was covered by epidermis and contained well-formed skin appendages such as hair follicles, sweat and sebaceous glands, as well as fatty tissue in the center It was classified as a choristoma These are a displacement of tissue in the course of development.

A case of asphyxia neonatorum due to a nasopharyngeal teratoma is reported by Kesson[50] This baby was a normal delivery but three hours after birth he suddenly became cyanosed and dyspneic. Examination showed a yellow mass in the oropharynx, and when the baby gagged, a sausage-shaped tumor was brought forward into the buccal cavity pulling the soft palate anteriorly A rubber catheter was passed into the pharynx beyond the tumor to provide an adequate airway The pedicle of the mass was then snared and the tumor removed whole without any anesthetic The relief from respiratory embarrassment was immediate.

The specimen measured 2x1x1 cm It was apparently covered by skin and there was a narrow pedicle Examination of the cut surface showed the center of the nodule to be occupied largely by adipose tissue Microscopically there was a small nodule of cartilage at the center and surrounding this a broad layer of adipose tissue The exterior of the nodule was covered by skin which showed well-marked keratinization and numerous pilo-sebaceous follicles The nodule was clearly a congenital malformation

Schindler, Hurwitz and Greenhood[51] reported the case history of a newborn with a nasophyngeal tumor at birth which caused the baby to have an unusual amount of mucus in the nose and throat, and made the infant choke and become cyanotic at first feeding

Examination disclosed a small white polypoid mass protruding about 3 mm from underneath the left posterior portion of the soft palate It was found to be attached by a pedicle to the region of the left fossa of Rosenmuller Whenever the child attempted to swallow, the mass would be drawn down and would obstruct the airway

The mass was removed with snare after first ligaturing the pedicle at its base No anesthesia was necessary Thereafter the child did well and at the age of four and one-half months there was no evidence of the tumor

Histologically the mass was covered by squamous epithelium, and numerous skin appendages were present including sebaceous and sweat glands, hair follicles, and fat and cartilage as well Such a teratoid tumor in the newborn is extremely rare

Cassidy and Wahl[52] presented two cases in which central nervous tissue occurred in nasal tumors of infants

These are difficult to differentiate from encephaloceles and meningoceles, which have central connections The test described by Furstenberg may be helpful In this test, pressure on the homolateral jugular vein will cause pulsating expansion in cases with intracranial communication but not in those without

These tumors are probably the result of congenital embryonal rest of displaced neural tissue

Nasopharyngeal fibroma is an interesting condition, and rare in England, according to Martin[53] The most urgent problem is one of treatment, and he reports on five cases

The paper discusses nasopharyngeal fibroma under the headings of definition, incidence, etiology, pathology clinical features and differential diagnosis as well as treatment and is well worth reading in the original article

The greatest danger of this tumor lies in its vascularity This diminishes as the patient grows older, and complete regression occurs after the age of 25, however, treatment is usually necessary before this age is reached, and the author's cases were nearly all treated in their "teens" The various types of treatment are examined and these are *1* Injection of sclerosing solutions, *2* Sex hormone therapy, *3* Radiotherapy, and *4* Surgery

The author believes that surgery is the best treatment, and the transpalatal approach gives a good exposure of the tumor He uses a transverse incision along the posterior edge of the hard palate and a second longitudinal incision about an inch long joining the former at its central point. The posterior edges of the palate bone and septum are removed and a good view of the tumor is obtained The mass is then removed as much as possible by diathermy

If the tumor does not seem to be excessively vascular, and it is considered that most of it has been removed, the palate is re-sutured Should there be any recurrence this may be dealt with by radiotherapy or diathermy, using post-nasal mirror control, however, if the tumor is very vascular and the operation apparently incomplete, a permanent opening or fenestation is left. This allows future inspection and treatment of the tumor by diathermy when necessary The author has found this a very satisfactory method of treating nasopharyngeal fibroma A permanent obturator is worn in the fenestration opening of the palate

Handousa and associates[44] from Cairo University discuss a clinicopathological study of 70 cases of nasopharyngeal fibroma They claim the disease is not so common in Egypt as usually stated in the literature, and is found more frequently among the poor people

An excellent pathological description is given with many illustrations of microscopic sections Most of their cases were between eight and twenty-two years of age and there were eleven females in the series, thus helping to disprove the view that this tumor is found only in males The origin of the growth was always from an attachment above the pharyngeal opening of the Eustachian tube Usually this was unilaterally placed in the roof of the nasopharynx, encroaching on the corresponding choana This tumor may hang down in the nasopharynx and depress the soft palate, also, it may extend into the nose, compressing both the septum on one side and the sinus walls on the other

The outstanding symptom is progressive nasal obstruction and recurring severe epistaxis Headaches do occur, but pain is uncommon The extension of the tumor may produce broadening of the nasal bridge, prominence of the cheek and eye with asymmetry of the face Diminution of hearing on the affected side is noted, but suppurative otitis media is rare A soft tissue X-ray will show the tumor hanging down in the nasopharynx and pharynx

Treatment is discussed under the headings of conservative, irradiation and surgical excision The ideal method of cure in the authors' experience is surgical excision The main danger of the operation is hemorrhage, and correct pre-operative preparation such as transfusion is essential in the anemic patient Satisfactory exposure is necessary, and the authors prefer a combination of the oral route with an external approach

They feel the best possible external approach is that attained by Moore's lateral rhinotomy The attachment of the tumor is located bimanually and the mucosa cut through by a suitable periosteal elevator Dissection is then carried out by gauze, which is forced in between the base of the tumor and the underlying bone As soon as the mass is freed it is removed by the oral route and the bed quickly packed with a long strip of vaseline gauze

This method controls the profuse oozing which is liable to occur when the tumor is freed from the underlying structures, and in these cases pre-operative carotid ligature was not necessary The operation is performed under general anesthesia and is preceded by tracheotomy and pharyngeal packing The nasopharyngeal packing is removed on the second day and the tracheotomy tube on the third day Antibiotics are given for about a week and blood transfusions where necessary Post-operative bleeding does not take place where the tumor has been completely removed Recovery is rapid and a cure attained in three to four weeks

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RESPIRATORY DISTURBANCES IN THE NEWBORN AND YOUNG INFANT*†

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INTRODUCTION

Conditions in the newborn and young infant producing respiratory disturbances with or without anoxia are many, and often of very complex nature. This discussion will in the main part be limited to those conditions in which abnormal structure or altered dynamics of the respiratory tract are responsible.

E. L. Potter[1] states that among 27,603 deaths occurring in the first 24 hours of life in the United States in 1946, 22,707 were due to prematurity. She believes "pulmonary immaturity," with inadequate oxygenation, was responsible in the majority of these cases. She goes on to state that between 1946 and 1949 death from anoxia in infants weighing more than 1,000 grams was 5.4 per thousand births at the Chicago Lying-In Hospital.

In 13,515 live births atelactasis was present 157 times, according to Clerf.[2] Ninety-five were in premature infants, while the remainder occurred in full term babies. Labate prefers the term "anoxia." He states that this is one of the three major causes of death in infants, the other two being malformation and birth trauma.

THE NOSE, NASOPHARYNX AND PHARYNX

Although subject to wide variations in size and shape, the nose is seldom abnormally developed. Anomalies of major importance in the nose are usually associated with other major defects, notably cyclops or cebocephalus. Obstruction of the nose in the newborn or young infant may produce severe asphyxial symptoms as well as difficulty in feeding. St. Clair

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Thomson[4] stated "with rare exceptions all infants breathe entirely through the nose If the nose of a sleeping infant is gently closed, he will waken and gasp for breath, instead of simply opening and using the mouth as an airway Even when mouth breathing is partially adopted to supplement the nasal airway the latter remains the route preferred by instinct and as much air as possible is drawn through it. Mouth breathing is an acquired habit."

Persistence of the primitive nasopharyngeal membrane or congenital choanal atresia may produce asphyxia in the newborn infant. Beinfield[5] and Mendovi and Beckmann[6] mention the occurrence of asphyxial symptoms in the newborn, due to the presence of atresia of the posterior nares Mendovi and Beckmann report five cases of such atresia in the newborn Bilateral occlusion was present in three cases, while in the remaining two the disease was unilateral

Symptoms were most severe and occurred early in the bilateral cases, while in the unilateral cases asphyxia was not present or was of mild degree and appeared only during the feeding period Presence of a unilateral nasal discharge was common to all the cases of unilateral atresia Beinfield[7] reports a case of a 16-year-old girl in whom unilateral nasal discharge had been present from birth

Early surgical treatment in the bilateral cases with asphyxial symptoms is urgent. The obstructing membranes should be perforated and a catheter left in place for a variable period of time post operatively in order to prevent the obstructions from re-forming In the unilateral cases treatment may be deferred until the patient is older, when the more satisfactory transpalatine approach of Ruddy[8] may be employed Choanal atresia is relatively uncommon, and most of the cases are reported in older children and adolescents For this reason many infants with this disease go undetected and probably have no symptoms from the disease until in later life

Cysts and tumors of the nasopharynx may obstruct the upper airway and produce the same symptoms of asphyxia as congenital choanal atresia. Other anomalous tumors originating in the nasopharynx may be dependent and obstruct the larynx or lower airway, producing intermittent cyanosis One such case was recently treated by the author, and report follows

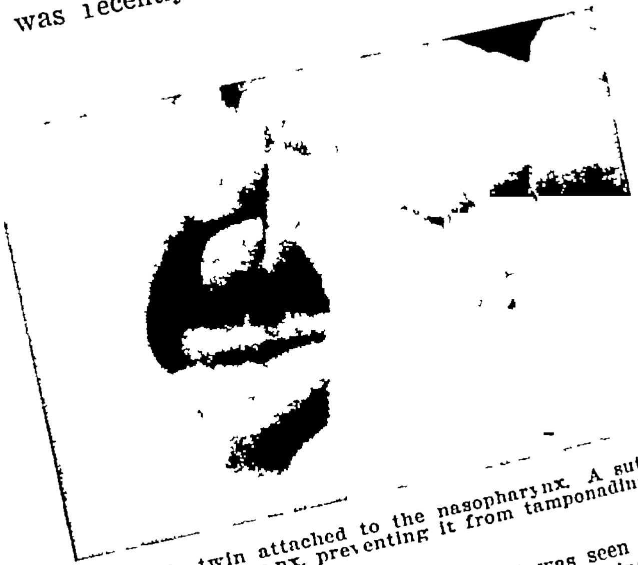

Fig 1 Parasitic twin attached to the nasopharynx A suture is holding the mass in the pharynx, preventing it from tamponading the larynx

Case Report A 4 week, white female infant was seen because of attacks of cyanosis associated with a loud metallic, clicking sound on inspiration The chest was clear on physical examination and X rays were negative During an attack the child would hyperextend her head There was a loud clicking sound which could be traced directly to the larynx with inspiration Marked inspiratory retraction and cyanosis developed On further examination a pedunculated mass resembling an accessory tongue was found hanging by a long pedicle from the nasopharynx into the larynx This was drawn out and a suture placed through it to hold it in place in the mouth The mass was smooth, somewhat flattened and had the appearance of a secondary, or accessory, tongue except for the absence of papillae

At operation the mass was removed by transfixing the stalk near the point of its origin and ligating it The mass had its origin in the nasopharynx on the right lateral wall just below the torus No other anomalies or defects were found Following removal of the mass the patient was entirely well and when seen several months postoperatively was gaining weight and there had been no further attacks of cyanosis

Examination of the mass revealed that it was covered with stratified squamous epithelium or skin and had most of the elements of skin while the center was made up of loose connective tissue elements

Since this structure has none of the elements commonly found in the region from which it arose it must be assumed that it was a parasitic twin or part of a second individual

Edith Potter and others report the occurrence of parasitic twins attached in the pharynx and nasopharynx In their cases, however, more parts of the second individual could be dentified than in the present case

As previously mentioned, infants are primarily nasal breathers This is due to the relatively high position of the larynx, the more or less constant apposition of the tongue to the palate, and the relative shortness of the lower jaw For this reason, space consuming lesions of the pharynx apparently rarely produce obstruction, unless they are unusually large. Flaccidity of tongue may produce stridor when the infant is placed on its back This is due, of course, to the pressure of the flaccid tongue against the posterior wall of the pharynx Hypoplasia or subluxation of the mandible may cause glossoptosis, which may give rise to cyanosis and difficulty in nursing

This condition may be fatal unless it is possible to overcome the obstruction of the pharynx caused by the position of the tongue The condition of hypoplasia of the mandible, with obstruction due to glossoptosis, is known as Pierre-Robin syndrome Cyst or lingual thyroid may produce similar obstructive symptoms requiring surgical relief

LARYNX, TRACHEA AND BRONCHI

The primitive larynx and trachea can first be identified as a local expansion in the upper anterior part of the primitive entodermal tube A longitudinal constriction pinches off the anterior part of the expanded area, producing a short cylindrical appendage that communicates with the esophagus only in its uppermost part. This appendage branches into a right and left branch, the left giving rise to two divisions and the right to three Clerf[9] quoting H E Radasch states that in embryos of the fifth week the laryngeal groove is bounded on each side by a rounded arytenoid swelling Ventrally, at the base of the developing tongue, these join to form a transverse ridge over the third and fourth branchial arches This is the epiglottic ridge or fold The arytenoid swellings and the epiglottic folds form a U shaped ridge called the furcula This slit like opening may be termed the primitive glottis

During the seventh week of development, each arytenoid swelling becomes bent or kinked near its midline so that the primitive glottis becomes T-shaped with the transverse portion at the epiglottis At this time the arytenoid swellings fuse and the primitive glottis is completely obliterated Clerf considers this apparently a provision on the part of nature to prevent the passage of amniotic fluid down the respiratory tube during early stages of development

About the tenth week, or shortly thereafter, this glottic fusion becomes dissolved and the arytenoid swellings lose contact with the epiglottis ventrally The glottis then becomes oval in form The position of the larynx in the neck of the infant is relatively higher than in the adult It is at the level of the fourth cervical vertebra, while in the adult it has migrated down to the level of the sixth vertebra. This is in part due to the relative increase in the length of the neck

Tucker[10] states that six millimeters is the normal subglottic AP diameter of the full term infant larynx Five millimeters he considers as abnormal, while four millimeters indicates a definite stenosis The larynx is also more flaccid and pliable than the adult larynx Hill[11] believes that this is due to the fact that the glottic rim and the epiglottis are composed of yellow, elastic fibrocartilage rather than the white hyalin cartilage, which form the thyroid and cricoid cartilages

Yellow cartilage is well known to be quite pliable, while hyalin cartilage is rigid and non-pliable The pharyngeal aperture of the larynx in the infant faces dorsally at a fairly acute angle After it has assumed the adult position farther down in the neck, the aperture becomes more transverse in relation to the long axis of the neck In addition, the movements of the infant larynx are somewhat different than in the adult In the infant, the arytenoids tend not only to move toward the midline but also ventrally toward the epiglottis, giving the impression of a distinct sphincter-like action to the glottic closure movement In the adult the arytenoids do not move toward the epiglottis or ventrally but move to the midline

Laryngeal stridor is one of the most common respiratory disturbances occurring in the newborn It is characterized by noisy inspiration at birth or shortly thereafter It is usually inspiratory, although when especially noticeable there may be an expiratory phase as well Voice sounds are normal, cyanosis is rare, although there may be, as we shall see later, an associated mild, diffuse atelectasis In most cases the symptoms disappear after the second year, or even earlier

Suffocation from this condition is rather rare although fatalities have been reported Two theories have been advanced to explain the mechanism of congenital laryngeal stridor, the first expounded by early authors who expressed the belief that the stridor was due to a central functional disorder, producing a disturbance in the coordination which takes place in ordinary breathing between the thoracic muscles on the one hand and those of the larynx on the other

Other writers, such as Hill and Tucker, express the belief that the stridor is due to the inspiratory collapse of the soft, pliable structures of the glottic rim of the infant larynx Hill[11] concludes that the epiglottis, if short and flabby, might be sucked inward but feels that this would be secondary to the laryngeal rim in causing stridor He states, however, that in one case traction on the epiglottis relieved the symptoms From the author's experience, the epiglottis rim, rather than the epiglottis itself, by its flabbiness and infolding with inspiration is thought to be the cause

Developmental defects of the glottis are chiefly of the web, band, or atresic type Hypoplasia of the larynx is of course, incompatible with life and extremely rare It may be, according to Potter, associated with hypoplasia of the tongue, trachea, esophagus and lungs Web of the larynx is probably the most common anomaly encountered, but even it is comparably rare Hudson[12] states that between 1932 and 1949 only nine cases of laryngeal web had been diagnosed at Baby's Hospital New York, where approximately 4 000 patients a year are admitted

As previously indicated the primitive epiglottic folds and epiglottis fuse primarily, and then this fusion later dissolves to establish the patency of the laryngeal airway persistence of fusion of the arytenoids and epiglottis results in laryngeal web The web usually occupies the space between the vocal cords near the anterior commissure however, all degrees are recorded varying from a slight web at the anterior commissure to almost complete fusion of the vocal cords, with only a small opening near the vocal processes or the posterior commissure

Edith Potter reports three cases deserving special mention, in which she found identical malformations of the larynx. She states that there was a solid mass of cartilage approximately three millimeters thick extending across the entire larynx immediately below the vocal cords. The upper and lower surfaces were covered with normal epithelium. In two of these cases a hair-like canal connected the upper and lower segments and was present posteriorly in the midline. These findings may be explained by the views of Arey,[13] who states that the larynx develops somewhat differently in its upper and lower parts. He feels that the lower portion forms around the stem of the trachea, whereas the upper part, including the vocal folds, arises from the pharyngeal floor in the region of the primitive glottis.

Symptoms produced by congenital laryngeal web vary considerably in severity, depending upon the degree of obstruction present. Thus a small anterior web may produce only hoarseness. With a greater degree of glottic occlusion stridor and dyspnea appear, while with even more severe degrees of obstruction, cyanosis and retraction of the chest wall make their appearance.

Flaccidity of the subglottic mucous membrane, lack of rigidity of the cricoid cartilage or its actual absence may also be responsible for stridor, dyspnea and cyanosis. These conditions, however, are uncommon, and are not present as often as congenital web.

Obstruction in the trachea can be divided into three major categories *1* Compression due to extrinsic lesions, *2* Intrinsic obstructions, and *3* Lack of rigidity of the tracheal wall. Tracheal tumors are rare, but when present, according to Potter, are most often found in the upper third of the trachea. They are principally papillomas, fibromas and angiomas. Symptoms produced are commonly a brassy cough and associated respiratory difficulty.

Collapse of the trachea is rarely responsible for respiratory difficulty in newborn infants. In the normal infant, a certain degree of inspiratory narrowing of the tracheal lumen is almost always present and by external pressure the trachea, and especially the bronchi, can be easily collapsed. Unusual flaccidity or absence of the tracheal rings may be responsible for symptoms of obstruction and stridor

Inspiratory collapse of the tracheoesophageal wall may produce dyspnea and cyanosis, thus Phelps[14] reports a case of a newborn infant who was a blue baby at birth and suffered from attacks of cyanosis at intervals On examination this child had a normal larynx The trachea was observed to close on inspiration from collapse of the party wall No other abnormality was found The infant lived a few days and at autopsy showed a normal larynx Phelps states that very few tracheal rings were present and that these were smaller than normal This, he felt, accounted for the tracheal collapse The author himself has observed one case of tracheal obstruction due to collapse of the party wall This infant was several days old when examined, was bronchoscoped without difficulty, and on inspiration a segment of party wall just above the carina was observed to balloon into the trachea producing a loud, fluttering sound This child survived stridor gradually subsided and had cleared entirely in six months

Tracheobronchial compression may be produced by congenital cardiovascular defects Hollinger[15] and later, Baker[16] divided these into two major groups The most common are due to congenital cardiac defects In these cases, compression of the left major bronchus is produced when an enlarged left auricle or ventricle encroaches on it. In the second group, anomalies of the aorta and great vessels produce constriction of the trachea and/or the left major bronchus Double aorta or so-called vascular ring, is the most common anomaly of this group The aorta divides and passes to either side of the trachea, reuniting between the trachea and esophagus Sometimes it unites again behind the esophagus The small size and softness of the infant tracheobronchial tree allows it to be compressed easily Obstructive emphysema as well as atelectasis, may result. These defects, can, in some instances be corrected by the thoracic surgeon Early diagnosis and treatment are essential because the prolonged use of an indwelling tracheotomy tube to hold open the collapsed trachea may produce erosion and fatal hemorrhage.

Congenital mediastinal cyst is also sometimes responsible for compression of the trachea Obstruction is usually at, or above, the carina

So-called enlarged thymus has been incriminated as a cause for tracheal compression, the author, however, does not hold to this view Edith Potter states "To my knowledge, hyperplasia of thymus has never been proved to have been the cause of death in the neonatal period I do not believe it causes death, either by mechanical compression of the trachea or by inducing some occult disturbance, generally designated as thymicolymphaticus Nor is there any reason to believe that it causes stridor or asthma The fact that the function of the thymus gland is unknown seems to be largely responsible for its indictment as a cause of sudden death Years ago, when the small thymus of a sick infant was believed to be the normal size, the discovery of the non-atrophic and normal thymus in any infant who had been ill led to the assumption that the gland was hypertrophied Large-scale X-raying of the chest to determine thymic size was done, and many diagnoses of enlarged thymus were made Since all lymphoid tissue shrinks under X-ray therapy the recommendation was made that the gland be reduced in size by this means In many communities the diagnosis is still made and X-ray therapy given"

She goes on to state "Among the 8,000 autopsies on infants under one year of age that I have been fortunate enough to observe, the thymus has never shown any abnormality that might have led to death It cannot be denied that infants occasionally die unexpectedly, but there is no evidence, unless an actual tumor is present, that the thymus is responsible or that X-ray treatment of the thymus would have prevented death"

Tracheoesophageal fistula is rare but responsible for severe dyspnea, cyanosis, and death in young infants Symptoms usually appear at birth, are more severe during the feeding period and result from aspiration when feeding is attempted This anomaly may vary from an opening or fistulous communication between the trachea and esophagus to complete absence of the upper segment of the esophagus In the latter case, the upper end of the esophagus ends in a blind pouch while the lower segment is attached to the lower end of the trachea communicating with it through a single opening This condition is thought to be the result of the incomplete separation of the primitive larynx and trachea from the primitive entodermal tube

Case Report A full term male infant with marked cyanosis, especially after attempted feeding Bronchoscopy performed and an anomalous opening into the lower segment of the esophagus was observed between the right and left main stem bronchi just at the carina. Bronchoscopic aspiration was performed several times during the first 24 hours of life with temporary relief of dyspnea and cyanosis The defect was repaired and the patient survived for three months postoperatively Pericarditis was found at autopsy and was probably the cause of death. The anastamosis of the lower segment with the blind pharyngeal pouch was successful and had healed completely (Case of Frank L. Gerbode M D)

THE LUNGS

Disturbed pulmonary function is by far the greatest factor in the production of asphyxia in the newborn and young infant As previously indicated atelectasis is one of the major causes of death in the neonatal period Knowledge of the changes in the lung both anatomically and physiologically is prerequisite to an understanding of the various pathological states of the lung which occur at birth

Until recently, it has been thought that the initial expansion of the human infant's lung was a very rapid process, completed in a very short period of time however evidence has been accumulated to show that this process is a gradual, uneven procedure requiring hours or even days in some cases to complete Thus Farber and Wilson[17] have stated that an infant's first breath is his most difficult one, and they found that it takes a pressure equal to about 25 cm of water to expand the infant's lung

Clement Smith[18] states that a full term infant can exert a pressure of from 40 50 cm of water on his lungs He feels that this is the upper limit of safety for pressures applied to it. The infant's cry at birth with the consequent closure of the glottis and spasmodic increase in intrathoracic pressure undoubtedly plays a part in this initial process

Hilding[19] and others have found roentgenographic signs of atelectasis persisting up to and in some instances beyond, 24 hours in otherwise perfectly healthy newborn infants Martin and Friedell[20] point out that the cardiac silhouette changes markedly with atelectasis in the newborn They point out that the transverse diameter of the heart and cardiothoracic ratio are increased in atelectasis, also of significance is the fact that the superior mediastinal shadow often appears wider These changes are, of course, much more marked than those normally observed in an infant during phases of inspiration and expiration

The diaphragm does most of the work in pulling the lung open Hilding also believes that this, as well as the change from the curled-up to the opisthotonic, stretched-out position, exerts the necessary piston-like pull that opens the lung initially Few references occur in the literature regarding the thoracic cage and its role in the expansion of the lung The writer believes that the state of the thoracic cage is extremely important in this initial expansion process He will attempt to elucidate this problem further and justify his position, however, at this point it is necessary to digress and consider certain other questions related to the expansion process

Respiratory movement in utero have been observed by many, and there is evidence to suggest that respiratory movements in utero occur in the human infant Clement Smith, however, cautions that present knowledge concerning the development of thoracic movements in utero does not allow the assumption that the onset of breathing at the time of birth is merely a continuation of this fetal activity There is contradictory evidence and difference of opinion regarding the presence or absence of amniotic fluid in the fetal respiratory tract Labate states that it probably fills the trachea but not the alveoli

Gruenwald[21] found fluid only in the alveoli of stillborn infants He found also that fluid would expand the atelectatic lung with far less pressure than gas, but, on the other hand, Hilding failed to demonstrate the presence of amniotic fluid in the respiratory tract of experimental animals, in which he had tied off the trachea after observing fetal respiratory movements in utero The author has bronchoscoped infants with "fetal atelectasis" and has not found convincing evidence of the presence of amniotic fluid

From the above evidence, and other evidence to be presented later, the writer believes that fetal respiratory movements are of such a nature as to allow the development of the thoracic muscles without the exchange of fluid or change in the volume of the thorax, and believes that this condition exists in the human fetus

Other factors are responsible for the initiation of the rhythmic respiratory cycle According to Clement Smith, the externally applied stimulus brought about by contact with a new environment and the chemical stimulus of hypoxia produced by separation from the maternal circulation produce this rhythmic respiratory cycle Modifying this picture is, of course, the state of the central nervous system One sees the gasping, irregular type of respiration more frequently in the premature infant. Smith goes on to state that high concentrations of oxygen rather than carbon dioxide tend to restore the higher centers and thus rhythmic respiration

It must be remembered that the fetus has an extraordinary tolerance for anoxia This is in part due to certain qualitative differences in fetal and adult hemoglobin The former has a greater affinity for oxygen at ordinary pressures, yet dissociation readily occurs at tissue pressures The blood of a full term infant contains a mixture of adult and fetal hemoglobin The premature infant, on the other hand has a greater percentage of the fetal type hemoglobin This would perhaps tend to make the premature infant more resistant to anoxia than the fully developed infant at term Higgins[22] observed a human fetus inside the intact membranes making vigorous respiratory movements for fully 28 minutes after the ovum had been separated from the maternal circulation

Brandau[23] records a remarkable experience He was called to attend a woman who had delivered a six months premature infant with membranes and placenta intact. Forty five minutes after delivery the "bag of waters" was ruptured and the baby recovered from the enveloping membranes Brandau says that the child's color was good, heart action excellent, and that he had no difficulty in getting the baby to breathe after clamping the umbilical cord, however death occurred 24 hours later because of respiratory difficulty and prematurity Autopsy was not obtained Brandau explains his observations by assuming that the intact fetal placenta was able to absorb enough oxygen from the atmosphere for the needs of the fetus No respiratory movements were seen through the intact membrane

Important also in the initial expansion process in the newborn lung is its state of development Edith Potter believes that the vascular bed, if underdeveloped, is responsible in many cases for atelectasis occurring in the neonatal period Farber and Wilson[24] were able to differentiate between the unexpanded infant lung and the one which has expanded and then becomes atelectatic In the former, the cells lining the alveoli are of a high cuboidal shape and quite regular With the initial expansion process these cuboidal cells become stretched out flat and irregularly spaced Consequently, if atelectasis occurs after this initial expansion the alveoli have a slit-like appearance, the cells are flattened, irregularly spaced and the vascular bed may be engorged This suggests the possibility that closure of the foramen ovali and ductus arteriosus which shunt the blood through the pulmonary artery and consequently through the lungs, may play an important part in the initial expansion process

Miller and Jennison,[25] Potter, Behole, Gibson and Miller,[4] and others have described a syndrome which is best termed resorption atelectasis with hyalin membrane This disease occurs more commonly in premature infants and those delivered by Ceasarean section Clinically the infant breathes spontaneously and seems perfectly normal to percussion and auscultation, and then within a few hours becomes cyanotic The initial cyanosis may be relieved by oxygen, but the respiratory rate and effort become more pronounced There is increasing retraction of the ribs and sternum with each respiration At this time signs of massive atelectasis are usually present The cyanosis becomes more severe, the respiratory effort more pronounced and is no longer relieved by oxygen Death frequently occurs within the first two days

On autopsy the the lungs are characteristic, they are the size of well-expanded lungs but have the consistency of liver They are of uniform dark red or purple color Pathologically, there is wide-spread collapse of the alveoli and the alveolar ducts There is capillary engorgement The inner surfaces of some of the alveolar ducts that remain open are covered by an irregular layer of homogenous and acidophilic material which may be the result of anoxic necrosis of the lining epithelium Miller, Potter and others believe that the presence of this hyalin material blocks the exchange of respiratory gases

Labate is of the opinion that pulmonary hyalin membranes are formed as a result of the absorption of the fluid portion of the aspirated amniotic sac contents Ranstrom,[37] after analyzing 30 cases of newborn infants with hyalin membranes in the lungs, concludes that the membranes are of no significant functional importance in the vast majority of these cases He thinks that the presence of large areas of atelectasis are responsible rather than the presence of a few scattered areas of hyalin membrane

Farber and Wilson have been able to produce experimentally hyalin membranes by hyperventilating the excised lung and introducing a foreign substance, such as ink or exudate, into the trachea Bubbles of air become trapped in the alveoli, thus forcing the hyalin substance against the alveolar wall and producing, according to these authors, the typical picture They also found hyalin membranes in other diseases where extreme respiratory efforts were made because of cyanosis Of further significance is the observation of Behole, Gibson and Miller, who found that these lungs could be made to expand by exerting sufficient negative pressure on the lung surface

The author has been fortunate in being able to collect 11 cases which clinically fit into the picture described above Six of these cases were examined and treated by the author while the remainder were treated by other physicians Marked inspiratory retraction of the sternum was present in all cases and increased in severity until traction was applied to the sternum. Cyanosis was well developed and appeared after a short period of well-being following delivery, in all cases except one In all cases recovery was prompt and permanent. Traction was maintained on the average for 24 to 48 hours The longest period of time for which it was maintained was five days All cases treated were considered in the premature group, the largest weighing five pounds, seven ounces, and the three smallest infants weighing three pounds or slightly less The details of two of these cases will be presented since they are complete and X-rays were taken before, during and after treatment

Case Report A four and one-half pound female premature infant exhibited sternal retraction at birth This increased and cyanosis was first noticed at the end of 12 hours Bronchoscopy was performed and the tracheobronchial tree found to be clear There was no improvement following this procedure Sternal traction was applied and immediate improvement in the child's color was noted On the following day breath

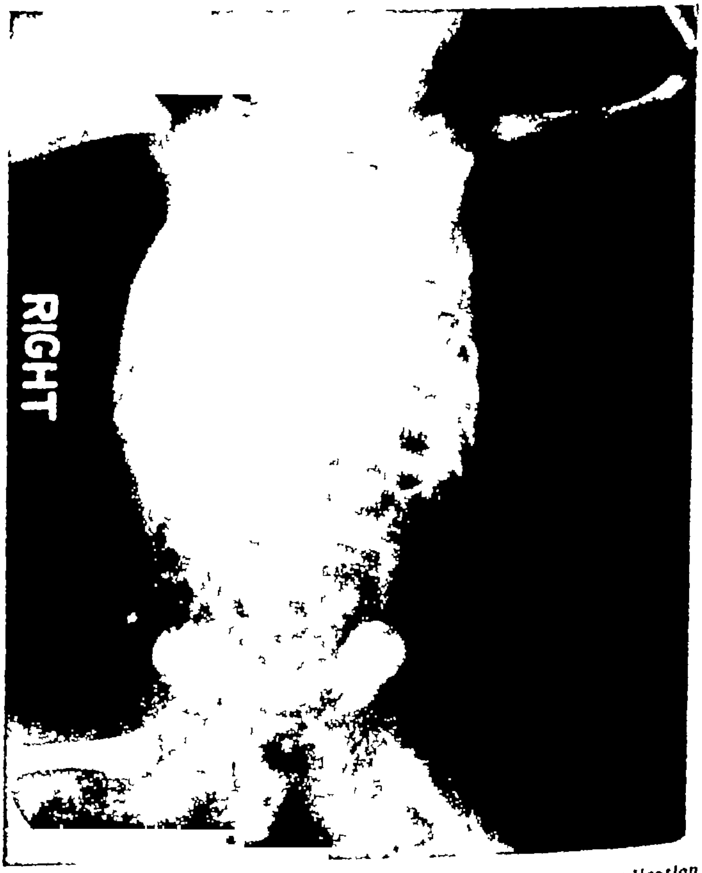

Fig 2A. Anterior-posterior view of the chest before the application of traction (Case of Dr Ralph Fisher)

Fig. 2B. Lateral view of the chest before the application of traction—expiration

Fig C Lateral view of the chest before the application of traction—inspiration

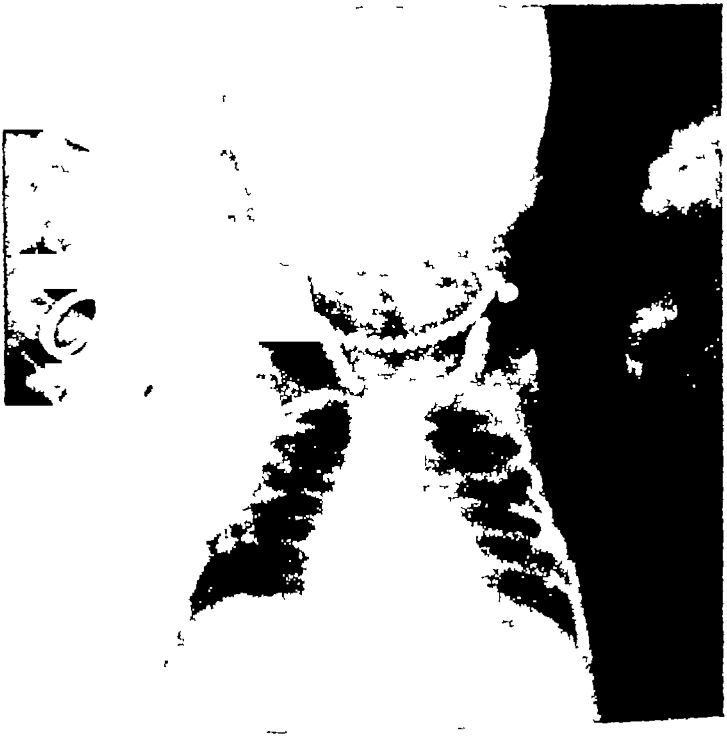

Fig 2D Anterior-posterior view Complete clearing Note changed appearance of the cardiac silhouette

sounds were heard throughout the chest and the color was good The suture was removed from the sternum and the patient had no further respiratory difficulty

In the following case the author was extremely fortunate in being able to secure films taken before, during and after the application of sternal traction These films were taken as nearly as possible in full expiration and inspiration

Case Report A five-pound two-ounce male infant born by Ceasarean section Cry and color were described as excellent immediately following delivery Even at that time however, retraction of the sternum was noted Two to three hours later the infant became cyanotic He responded to oxygen but in spite of this therapy the extremities remained dusky Two days after delivery traction was applied with almost immediate improvement in color Traction was left in place for approximately 24 hours Subsequently the chest remained out and the patient is alive and well today

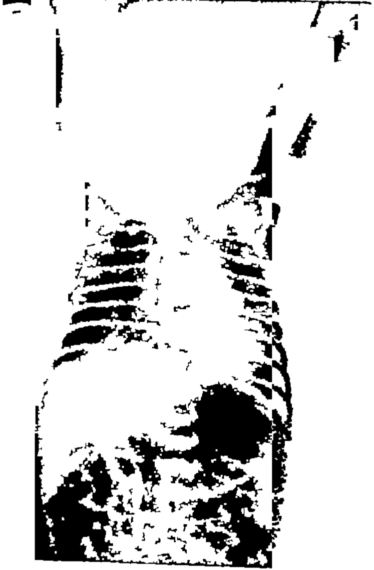

Fig 3A Anterior posterior view of the chest before traction (Note the air containing tracheobronchial tree which can be traced to its finest divisions)

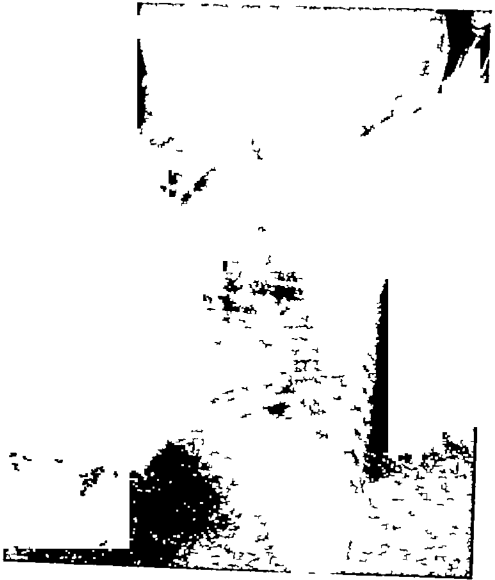

Fig 3B Lateral view—before treatment—inspiration.

Fig. 1C. Lateral view [illegible]

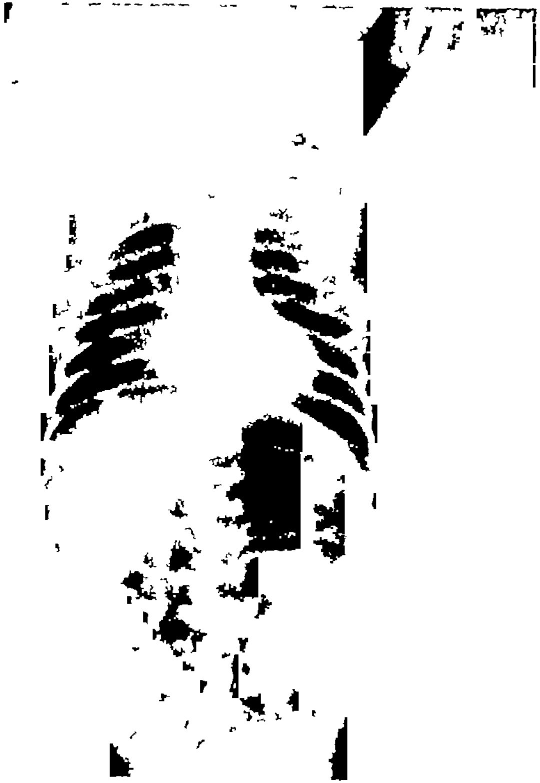

Fig. 1B. Anteroposterior view of chest [illegible]

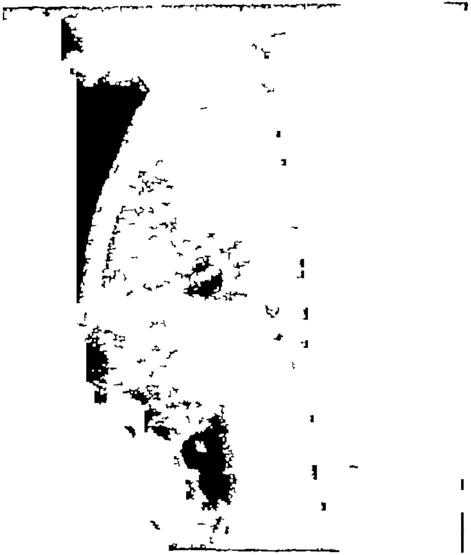

Fig 3E. Same as (D)—lateral view

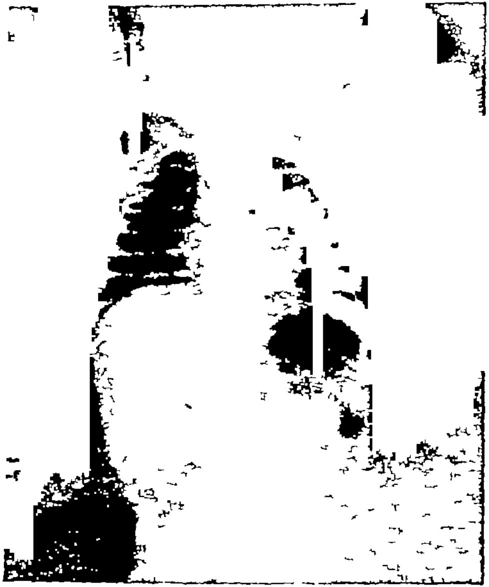

Fig 3F Anterior posterior view — 48 hours after removal of traction

Fig 310 Lateral view—48 hours after removal of traction

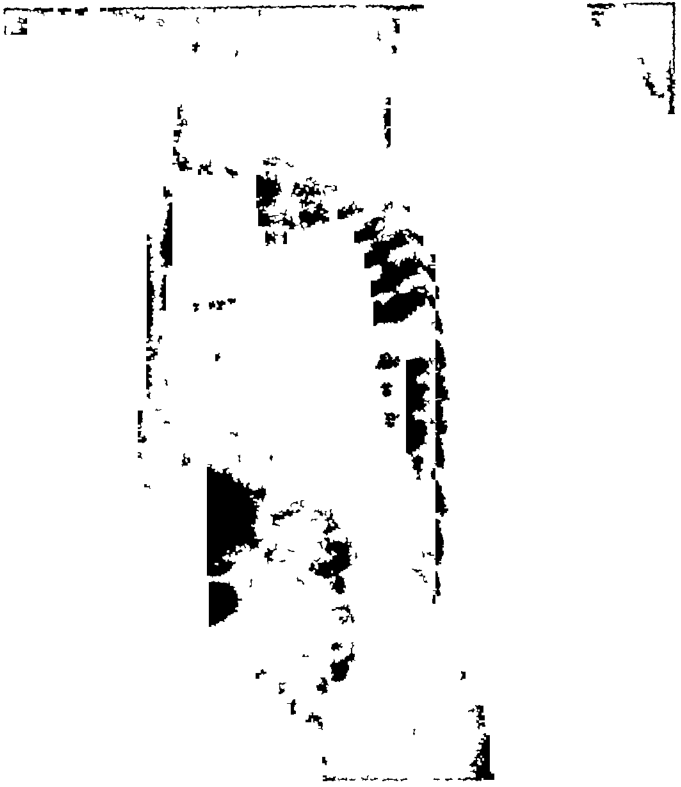

Fig 311 Same as (Q)—Inspiration (Note slight forward movement of the sternum)

ELEVEN CASES OF ATELECTASIS IN THE NEWBORN TREATED WITH STERNUM TRACTION

Delivery	Sex	Weight	Cyanosis	Thorax	Chest X ray	Remarks
1 Spontaneous	M	4 lbs 7 oz	Two hours after delivery marked	Marked retraction	Bilateral patchy atelectasis clear after traction (4 days)	Traction applied 18 hours after delivery Immediate improvement in color Traction removed at 4 days sternum remained out.
2 Caesarean	F	5 lbs 2 oz.	Cyanotic shortly after delivery	Retracted from birth	Bilateral patchy fetal atelectasis" showed marked X ray improvement with traction	Color improved with traction traction applied 12 hours chest remained expanded
3 Breech	F	2½ lbs	Color labile	Marked retraction rapid respiratory rate	None	Traction applied with improvement. Respiratory rate slowed Traction in place 4 days and released patient well 1 week retracted again Traction re-applied with improvement After 5 days no retraction alive and well 6 months later
1 Caesarean	F	4 lbs. 3 oz.	Marked from birth	Retracted from birth	None	Placed in airlock at delivery became worse. Traction applied 30 hours after delivery Immediate improvement in color No cyanosis in room atmosphere traction for 12 hours Complete recovery
5 Caesarean	M	4 lbs 8 oz.	1½ hours after delivery	Retracted 1½ hours after delivery		Placed in Bloxom airlock condition worsened with increase in cyanosis and retraction At 20 hours traction instituted with improvement in color and respiration Traction removed 8 hours later no cyanosis
6 Spontaneous	F	4 lbs 6 oz.	Marked at 12 hours	Retracted from birth	Marked bilateral fetal atelectasis cleared after traction	Bronchoscoped no improvement. Traction applied with marked improvement. Removed after 24 hours with no further difficulty

ELEVEN CASES OF ATELECTASIS IN THE NEWBORN TREATED WITH STERNAL TRACTION

Delivery	Sex	Weight	Cyanosis	Thorax	Chest X ray	Remarks
7 7½ mos Premature	Not stated	Approx 3 lbs	Marked at 3 days, in spite of O_2	Retracted at 3 days	None	Traction for 48 hours Immediate and marked improvement, which was sustained (Case of Dr George Y Elson)
8 Not stated	Not stated	Approx 3 lbs	Marked at 3 days, in spite of O_2	Retraction marked at 3 days	None	Marked immediate and sustained improvement after 48 hours of traction (Dr Geo Elson)
9 Breech, very difficult	M (Negro)	5 lbs 7 oz	Marked, incompletely relieved by O_2	Extreme retraction at birth		Immediate improvement in respirations and color with traction Recovered in 24 hours without retraction or distress Convulsions at 5 days, E Coli meningitis cleared with antibiotic therapy Well at one month (Case of Dr Benson Roe)
10 Normal spontaneous	M (Negro)	4 lbs 13 oz	Present at 5 hours, relieved by O_2 on 3rd day unrelieved by O_2	Retraction at 5 hours	None	Traction on the 3rd day, suture pulled out of sternum several times Slight but definite improvement Septicemia hem staph sur due to sternal wound infection Cleared with penicillin, baby discharged well (Case of Dr Benson Roe)
11 Spontaneous Breech (Pre-eclamptic mother first of twins)	M	6 lbs 3 oz	Absent at birth present 2 hours after delivery Relieved by O_2 Unrelieved at 24 hours	Retraction from birth	None	Traction (suture through the xyphoid) at 30 hours Cyanosis disappeared immediately Traction removed after 3 days Full recovery (Case of Dr Benson Roe)

NOTE The author's six cases treated by sternal traction were done in the following manner A braided cotton or silk suture was passed through the xyphoid The suture was then attached to several stout rubber bands which were in turn attached to the incubator roof Tension was adjusted until the desired effect was obtained and varies from one case to the next

The above experience suggests the distinct possibility of some other explanation for the syndrome termed "resorption atelectasis with hyalin membrane" Although statistical evidence is lacking, and the series of cases is admittedly small the writer believes that serious consideration should be given to another theory of the pathogenesis of this condition, namely the theory of "congenital flail chest." Traumatic flail chest is too well known to need discussion in this paper The mechanism in the above cases, the author believes, present certain striking similarities to the traumatic type Most important of these is the paradoxical movement of the sternum, which retracts with inspiration in both types of "flail chest"

In the newborn and especially in the premature infant the thoracic cage is a relatively soft and somewhat pliable structure The lungs, on the other hand, are elastic and tend to resist the pull of the diaphragm, which even at this stage of development is a comparatively powerful muscle In this manner the chest wall, the least resistant of the two gives way When traction is applied to the sternum, the diaphragm is given something to fix against and more of this force is directed toward "pulling' open the lung

This phenomenon was strikingly illustrated in one of the above cases. In this instance the infant's sternum began to retract and cyanosis returned as soon as traction was released When the sternum was again stabilized cyanosis disappeared immediately and good oxygenation was maintained even in room atmosphere This observation was repeated several times

It must be emphasized here that traction must be resilient to allow excursions of the chest wall, and of sufficient force to counterbalance the pull of the diaphragm Further support for this theory can perhaps be derived from the observations of Berglund and Eder [8] These workers performed open thoracotomy on two infants with this syndrome They found that the lungs inflated quite readily with the chest open, when positive pressures were used which had previously failed to inflate the lungs with the chest wall intact Their work tends to confirm the observations of Flagg [29] who found that he could inflate the atelectatic lungs (of infants) under water, with pressures which would not inflate them *in situ* In Berglund and Eder's two cases, the lung protruded through the thoracotomy wound This would suggest that the fully expanded lung tended to occupy more volume than the thoracic cavity provided This might have been due to the production of emphysema, but this does not seem likely in view of the low positive pressures used for inflation

Baggott[30] observes that in massive atelectasis something must make up for the lost volume of air in the chest. He suggests that this lost volume of air is replaced by blood in the form of intense capillary engorgement of the pulmonary bed He states the "law of the thorax" thusly

"The mass of the alveoli, of the vessels (or of the blood) or of the interstitial tissues may vary, but the sum of their masses must be at least equal to the capacity of the thorax in maximal expiration"

Baggott suggests that before birth the lungs fill the chest because of the presence of a supplemental mass of blood in the lungs The observations of Farber and Wilson do not support this view, also, this would not explain the changes in the cardiovascular system which shunt the blood through the lungs for the first time at birth Another possibility suggests itself Collapse of the sternum may allow reduction of thoracic volume in utero, and the paradoxical motion may permit the development of intrauterine respiratory movements, without affecting the volume of the chest This offers a possible explanation for paradoxical movement of the sternum, observed so frequently in newborn infants, thus, "congenital flail chest" may represent a fetal type of respiratory movement. The writer realizes that there are no observations of direct nature at the present time to confirm this theory

In the preceding paragraphs the writer has discussed collapse of the lungs, which he believes is due to pressure changes exerted at the lung surface Congenital defects of the diaphragm, with herniation of the abdominal contents into the thorax, by consuming the available space prevent the expansion of the lung These defects may produce severe respiratory distress and marked cyanosis Resuscitation is, as a rule, only temporary, and these distressed infants rarely survive beyond the 24-hour period The defect is usually not found until autopsy, and the diagnosis will not be made unless one is thinking of this defect Surgical reduction and repair of the defect in the diaphragm must be done early

The following is an illustrative case in which the author was requested to bronchoscope a patient who was apparently suffering from unilateral massive atelectasis

Case Report A full term male infant whose delivery was uncomplicated Cyanosis was present from birth and was quite marked unless oxygen was given The respirations were vigorous and rapid The chest wall did not retract. The left chest was entirely flat to percussion and no breath sounds were heard The heart was heard and felt on the right side of the chest The abdomen was flat and the costal margins were seen to draw in slightly with each inspiration No bowel sounds were heard in the chest. Because of the flatness of the abdomen and the absence of sounds in the left chest, together with displacement of the heart to the right side congenital diaphragmatic hernia was suspected X rays confirmed this opinion

Dr Henry Silvani operated on this patient and found a large defect in the left leaf of the diaphragm through which most of the bowel and stomach had herniated The hernia filled the entire left chest and was easily reduced The left lung was found compressed against the mediastinum and completely collapsed. The diaphragmatic defect was closed and a small incisional hernia made The hernia contents could not be immediately replaced in the abdomen because the capacity of the abdomen was too small to allow closure of the diaphragm without tension.

Approximately ten days later the hernia was repaired. Serial X rays of the chest showed that the left lung gradually expanded and the last film showed complete expansion. The child made an uneventful recovery except for an episode of bowel obstruction necessitating a second laparotomy Following this experience the child was entirely well and developed normally When last heard from six months later he was entirely well.

Until fairly recently congenital diaphragmatic hernia was thought to be inoperable Harper and Anderson[21] in 1930 wrote "The heart and lungs are displaced to the opposite side of the invading abdominal organs There is also a marked lack of development of one or both lungs a significant point to be considered in any proposed surgical treatment." They concluded that immediate surgery is contraindicated

As previously indicated, incomplete development may prevent the expansion of the lung Arrest of development may occur at any stage and may be slight or extensive. Symptomatology is quite variable No symptoms may be present or severe respiratory distress with cyanosis may occur In the latter case the outcome is usually fatal Bronchoscopy and bronchography may be of great value in differentiating this from other conditions, as the following case illustrates It is also of interest to note that the right lung is most often affected No explanation for this is offered Death may occur suddenly at any time without warning

Case Report A one-month old female infant had been wheezing from birth, but at no time had exhibited respiratory distress or cyanosis She was referred for bronchoscopy because of the appearance of the chest X ray The right side presented an almost opaque appearance The cardiac silhouette was absent from the left side Bronchoscopy was performed and revealed that the right main bronchus ended in a blind sac Several tiny openings in it could be made out. Bronchography revealed a small cystic dilatation of the end of the right main bronchus The left main bronchus was tremendously elongated and revealed that the left lung had herniated around to the right side and had almost completely filled the right thorax as well as the left. The patient expired suddenly one month later, and no explanation for her death was found at autopsy which confirmed the above findings in the chest. No other associated anomalies were present, however, the head in this case unfortunately was not examined

Thomas and Boyden[32] report three cases of agenesis of the right lung, including one death while a foreign body was being extracted from the left main bronchus It is of interest to note that the right side again was the side of predilection for the failure of development These authors present an extremely extensive review of the literature on this subject and suggest that lack of Vitamin A in the maternal diet or an hereditary factor may be responsible

Two types of atelectasis in the newborn have been discussed in the preceding paragraphs, *i e*, *1* Collapse due to pressure changes exerted at the lung surface, and *2* Failure of pulmonary tissue to expand A third type, due to the resorption of air from a segment of pulmonary tissue distal to an obstructed bronchus is equally important Bronchoscopy is most successful in this type of case since it is usually due to aspiration Obstructing material may find its way into the tracheobronchial tree at any time during the delivery or postnatal period

Farber and Wilson, Potter, Labate and others mention the presence of large numbers of epithelial cells which are occasionally found filling the alveoli of the lungs of infants dying of asphyxia This phenomenon is thought to be due to the initiation of pulmonary respiration brought on by a period of intrauterine anoxia Likewise so-called "congenital pneumonia" is thought to be the result of intrauterine aspiration of infected amniotic sac contents The writer has had no experience with either of these conditions

Atelectasis following postnatal aspiration is easily understood since the mechanism of its production and the pathology are similar to the condition in the adult. One or both sides may be involved, or it may be limited to one or two lobes of the lung The amount of distress produced depends upon the extent of involved pulmonary tissue It may subside spontaneously or result in pneumonia Aspiration atelectasis in the newborn should not be confused, however, with "persistent physiological fetal atelectasis" In the writer's opinion any infant who shows persistent areas of collapse which fail to expand after a reasonable period of observation should be bronchoscoped

The following case illustrates the sequence of events which may result from aspiration during feeding

Case Report A nine pound eleven ounce white male infant delivered spontaneously Color was excellent and cry vigorous At the time of the breast feeding the infant was noticed to be cyanotic and apneic The baby responded to Carbogen and ¼ cc. of Coramine. Forty-eight hours later chest films revealed the presence of atelectasis in the right upper lobe By this time the baby was running a low grade fever and the X ray findings of atelectasis persisted Fever and prostration continued for about a week and responded to penicillin Two months later the baby was referred because of persistent consolidation of the right upper lobe X rays taken immediately before bronchoscopy confirmed this finding At bronchoscopy the tracheobronchial tree was entirely clear however ¼ per cent Neosynephrine was applied topically to the orifice of the right upper lobe and spot suction applied. Films were taken following bronchoscopy showing partial clearing and on the following day the right upper lobe was entirely clear The baby has developed normally and at last report, some three months later was entirely well

Diffuse bilateral partial atelectasis may occur with partial obstruction of the upper airway as the following case of laryngeal stridor associated with atelectasis illustrates

Case Report A three-month-old white male infant who had had attacks of stridor dypsnea and cyanosis from birth was referred because the chest X ray revealed a wide upper mediastinal shadow with considerable collapse of the left upper lobe and patchy areas of density in the remaining portions of the lung. When examined under anesthesia the larynx was found to be flaccid and the aryepiglottic folds collapsed inward with each inspiration. Bronchoscopy was normal although small amounts of mucous were aspirated. Following this procedure the mediastinal shadow disappeared and the cardiac silhouette assumed the adult configuration Several days later the patient had another attack of cyanosis and a chest film revealed essentially the same findings as before bronchoscopy

SUMMARY

Atelectasis is the most frequent finding in neonatal death Birth trauma and congenital defects are of lesser importance

Defects of structure and function of the upper air passages producing respiratory disturbances are discussed A case in which a dependent congenital tumor attached to the nasopharynx, producing glottic obstruction, is presented The tumor is believed to be a so-called "parasitic twin"

Conditions giving rise to tracheal obstruction in the infant are reviewed Three types may be recognized intrinsic, usually produced by tumors, and more rarely congenital malformation, extrinsic lesions producing compression, commonly due to congenital cardiovascular defects, and rarely mediastinal cyst or tumor, and collapse of the tracheal wall, associated with absent or defective cartilaginous tracheal rings The writer's experience with collapse of the tracheoesophageal wall in one case is presented Contrary to earlier beliefs, massive diaphragmatic hernia is best treated by early surgical reduction and closure of the defect A case report is included

Repeated, early bronchoscopic aspiration in tracheo-esophageal fistula may be life-saving and make surgical repair possible A case report is included

The syndrome "pulmonary hyalin membrane with resorption atelectasis" is discussed Eleven cases treated by sternal traction are presented It is suggested that according to the "law of the thorax" the paradoxical movement of the chest wall allows intra-uterine respiratory movements without changing the volume of the thorax appreciably It is further suggested that the movements of the thorax observed in "congenital flail chest" are persistent fetal respiratory movements Observations of a direct nature in support of this theory are not presently available

Agenesis, or failure of pulmonary development, is variable in extent and degree Symptomatology is, therefore, varied This anomaly is a rare occurrence and most frequently involves the right lung A case report is included

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EXTERNAL UMBO BLEBS

Non Inflammatory Lipoid Vesicles of the Tympanic Membrane *†

B W ARMSTRONG, M D

Charlotte, N C

Myringitis bullosa is well-known to all who practice otology, and yet the literature on this subject is suprisingly meager Even less has been written concerning non inflammatory blebs commonly seen at the umbo The purpose of this paper is to record observations on lipoid blebs at the umbo, an entity that has been almost completely ignored The material presented was obtained in the course of exactly 24,000 consecutive and unselected office examinations during the five-year period 1949-1953

My attention was first directed to blebs at the umbo in 1946, when a 2 mm glistening elevation was observed at the tip of the malleus handle (see Fig 1) The patient had no history of ear disease and no complaint referable to the ear Incision into the bleb permitted the escape of a thin, clear fluid, and, thereafter, the drum appeared to be perfectly normal

HISTORICAL REVIEW

Buck[1] described six instances of cysts of the tympanic membrane in his textbook published in 1889 Of these, one was described as being between the substantia propria and the outer dermoid layer in the very center of the drum membrane and measuring nearly 3 mm in diameter The cyst contained ' apparently pure serum, unmixed with blood" and disappeared soon after the contents had been evacuated No further record of this type of cyst (or bleb) appeared for over 60 years. Politzer's[2] comprehensive monograph on the

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membrana tympani did not include them Other varieties of cysts were briefly discussed in the textbooks written by Heiman[3] and Keeler[4] Fowler[5] mentioned bleb-like structures of the drum in 1947, but made no reference to blebs at the umbo

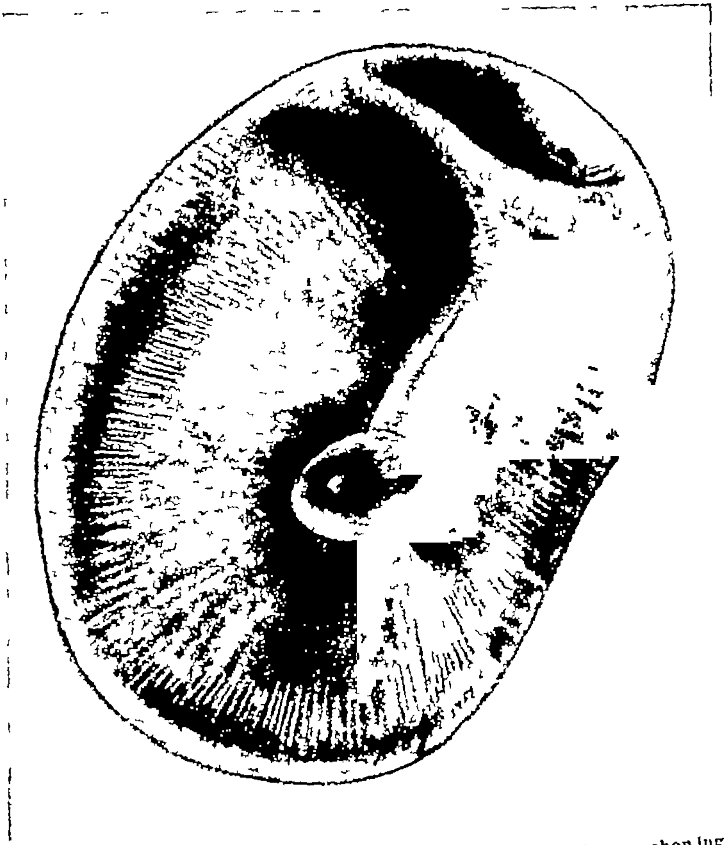

Fig 1 Artist's drawing of the right tympanic membrane showing a dermal bleb at umbo

In 1952, Wible[6] directed attention to a "frequently observed change seen at the umbo in cases of secretory otitis media" and reported his observations in three patients He described a fluid collection at the umbo which sometimes exhibited a fluid level He stated that some of the collections of fluid were subdermal and others submucosal His patients complained of difficulty in hearing and egophony and were relieved by incision and aspiration of the fluid.

Friedman[7] published his findings in five patients with "hydrops at the umbo," in 1954 The blebs were incidental findings in two patients, while the others were thought to have caused pain, tinnitus, and stuffiness of the ear He theorized that the fluid could be a transudate or an accumulation of lymph

Epidermal and mucosal blebs at the umbo have also been observed by Lathrop[8] and Arnold[9] Because the blebs in their patients were asymptomatic without exception, they regarded them as incidental findings Their cases have not been recorded in the literature.

Although vesicular lesions at the umbo have been reported,[1,6,7] the pathology apparently has not been investigated No record of a histopathologic study or even an examination of the fluid has appeared in the literature. Wible[6] discussed two separate types of lesions, "subdermal' and 'submucosal," as though they were one entity It is my belief that he actually observed two distinctly different conditions, each having its own significance Umbo blebs occur on the epidermal and mucosal surfaces of the tympanic membrane, but there is no evidence that they have the same etiology or pathology

DESCRIPTION OF UMBO BLEBS

These benign, asymptomatic blebs are invariably situated in the center of the drum They vary in size from 1 5 to 4 mm in diameter and appear as a smooth elevation, often glistening, and brighter than the rest of the drum (see Fig 2A) A bleb may resemble a droplet of dew on a gray petal (see Fig 2B) The margins are frequently marked by a faint ring of pallor These blebs are common yet easily overlooked They are probably dismissed by many otologists as an unusual light reflex or an optical illusion!

Of the 66 umbo blebs observed in the past five years, 63 were external to the manubrium of the malleus, and only three were medial to the manubrium The mucosal blebs are much more difficult to recognize, and some may have escaped

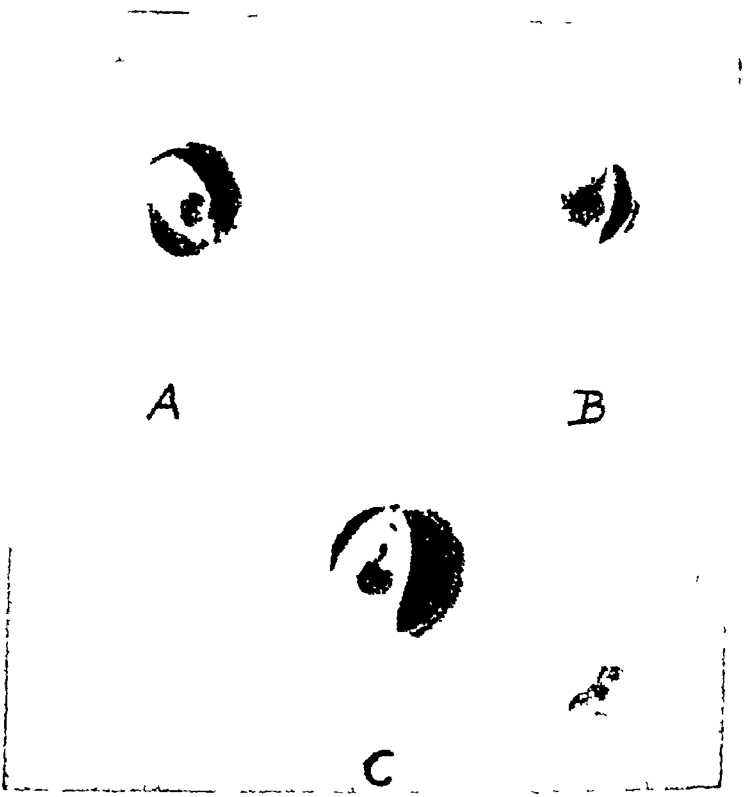

Fig 2 External umbo blebs.
A. Highlights give bleb a glistening appearance
B Very delicate bleb Note incomplete ring of pallor
C Bleb undergoing absorption Note wrinkled margins

detection * Both types of blebs tend to disappear spontaneously in a matter of several weeks or months As they diminish in size, the margins become wrinkled (see Fig 2C), Recurrences have not be observed There was nothing to suggest an intra-vesicular fluid level in any of my cases

INCIDENCE

Sixty-six umbo blebs were found in 58 patients during 24,000 examinations, giving a relative incidence of one for

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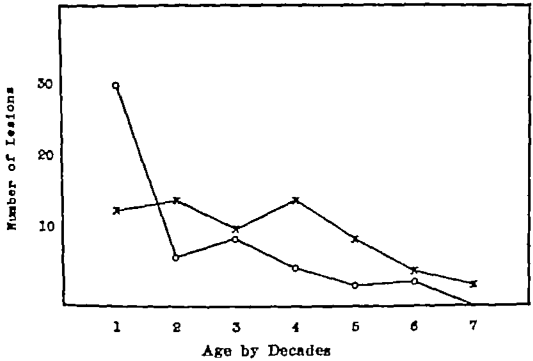
* The number of mucosal blebs in this series is so small that the study has not been extended to include them other than to record their existence It is assumed that they are a separate entity having a different etiology and pathology from the epidermal blebs

every 364 examinations * A tabulation of the distribution according to sex revealed that 42 of the patients were female and only 16 were male. The age incidence was fairly uniform up to the age of 50 (see Chart I) This is in contrast with the acute vesicular lesions which are much more common in the first decade of life The seasonal incidence of umbo blebs is indicated in Chart II

CHART I



Umbo Blebs X Myringitis Bullosa O
AGE INCIDENCE

During the same period in 52 patients with myringitis bullosa (both serosa and hemorrhagica) were seen The age and seasonal incidence of these cases is also indicated in Charts I and II respectively, to illustrate the contrast between myringitis bullosa and umbo blebs Admittedly, the number of cases may be too small to give an accurate concept of seasonal, age, or sex incidence

ETIOLOGY

The etiology remains unknown It is interesting to note, however that the three periods in which most of the blebs

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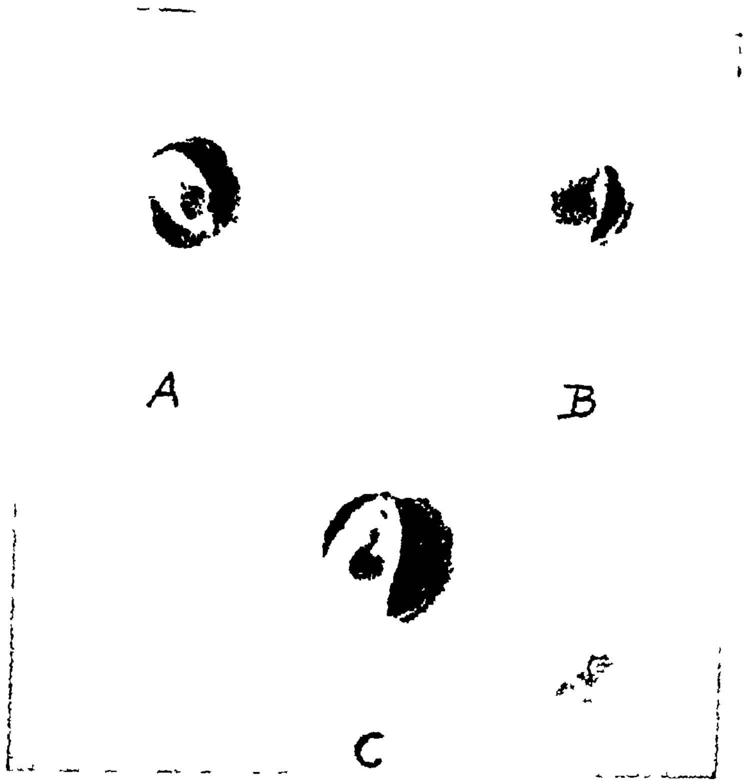
The relative incidence was computed by dividing the total number of patient visits (24 000) by the total number of blebs (66) Although each bleb was counted only once many patients, both with and without blebs made repeated visits during the five-year period represented, and each visit was recorded. The true incidence is, therefore considerably higher



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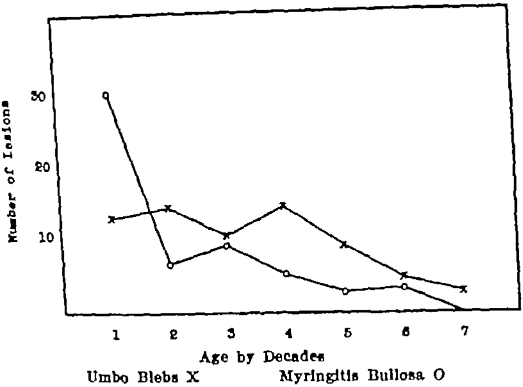

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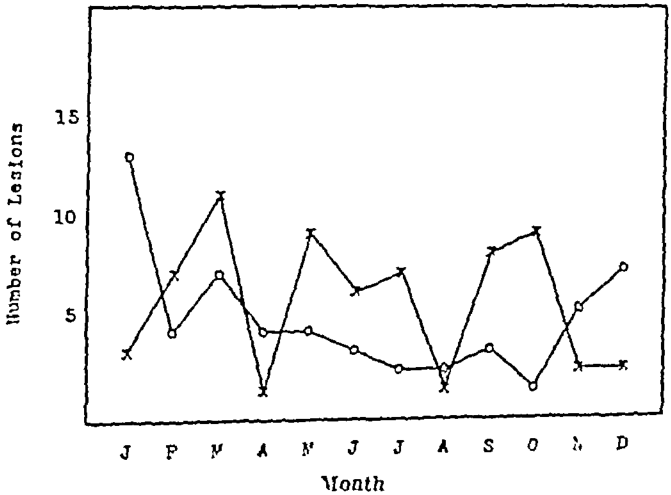
Neither trauma nor "local noxious stimuli" appeared to be responsible for bleb formation Circulatory disturbances were not considered to be factors in producing blebs There is an abundant blood supply along the manubrium, and other evidence of impaired circulation is lacking

CHART II



Umbo Blebs X Myringitis Bullosa O
SEASONAL INCIDENCE

There has been nothing in any of these cases to suggest a diagnosis of herpes It has been stated,[8] without supporting detailed evidence, that blebs of the drum are occasionally due to tuberculosis This is open to question, since tuberculosis is not characterized by bleb formation There was no evidence of tuberculosis in any of my patients

There was no apparent relationship to acute upper respiratory infections This is in contrast with the fact that, in this series, 39 out of the 52 patients (75 per cent) with myringitis bullosa had associated acute upper respiratory infections Unlike Wible's[4] patients, only one patient in this series had secretory otitis media at the time the bleb was under observation

In considering the etiology of this lesion, the fact that epithelial growth progresses from the umbo toward the periphery assumes significance The position of the lesion suggests that its formation may be related to this pattern of regeneration, peculiar to the tympanic membrane

PATHOLOGY

These blebs are exceedingly thin-walled It was only after many unsuccessful attempts that a specimen was obtained and sectioned (see Figs 3 - 4) The pathologist's description follows

> "Microscopic The specimen represents a longitudinal section perpendicular to the surface of the drum. Only the outer epithelial covering is seen. It is composed of several layers of epithelial elements varying in shape from cuboidal to flat. They produce a bright pink layer of keratin like material in which occasional flat elongated pyknotic nuclei can be seen and which are covered on one surface by delicate pinkish stained keratin lamellae. The substantia propria and the mucous membrane are not contained in the specimen.
>
> A long intra-epithelial slit is present in the central portion The base of the slit is a linear membrane composed of a few layers of compressed stratified squamous cells The roof however is undulating and consists of the continuous upper layer of epidermis covered by keratin lamellae. On either side the upper and lower layer of epithelium can be seen to merge into the intact epithelial covering of the drum. Although the vesicle is completely empty in all sections it cannot be regarded as an artefact for as indicated by its undulation the continuous epithelial layer of the roof is much longer than the corresponding basal portion. This configuration is indicative of a collapsed pre-existing vesicle. There is no evidence of intercellular edema or inflammation in the specimen examined."

The fluid within the blebs was crystal-clear except for two instances in which it was burnt orange in color No cellular elements or organisms were demonstrated in any of the smears The fluid contained large, occasionally confluent, drops of a sudanophilic material Smaller irregular particles polarized light, but the Liebermann Buchardt reaction for cholesterol was negative No crystals were observed in any of the smears. The thin, oily fluid will not dry, even after standing for several days

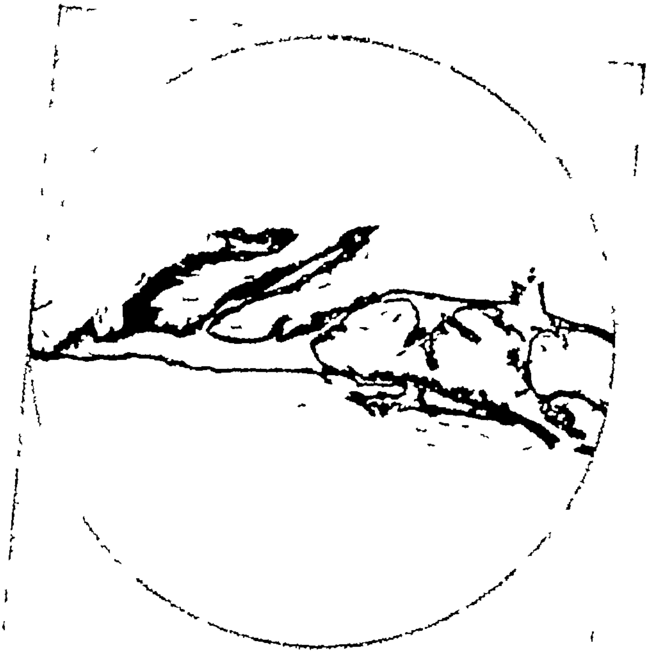


Fig 3

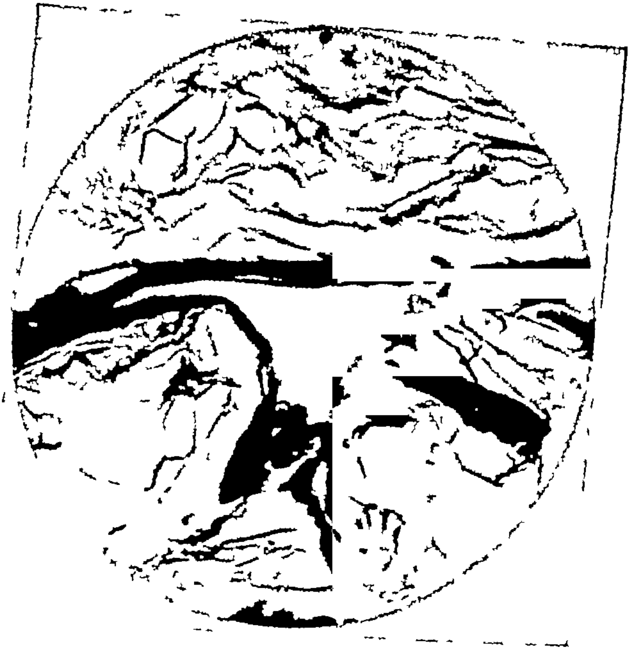


Fig 4

It is evident from the above that previous writers[1,8,7] have erroneously assumed that umbo blebs are necessarily subdermal (or submucosal) The section illustrated in Fig 3 clearly shows the lesion to be intra-epidermal The lack or scarcity of circular fibers[7] in the substantia propria at the umbo cannot be a limiting or contributing factor, because the substantia propria is not involved

Friedman[7] referred to this condition as "hydrops at the umbo" Hydrops is taken directly from the Greek word *hydrops*, meaning dropsy or an excessive accumulation of clear, watery fluid Since the fluid in the blebs is oily, it is evident that the term "hydrops at the umbo" is inaccurate and should not be employed

Wible[8] has reported a fluid level within the blebs in some of his patients. It is difficult to explain the presence of air or other gases in a non inflammatory vesicle In view of the above findings, it seems more probable that he observed a line separating layers of watery and oily fluid The difference in the refractive index of water and lipoid might give the illusion of a line of demarcation between fluid and air

External blebs at the umbo probably represent a primary degenerative lesion of the epithelium No inflammatory exudate was observed Although actual necrosis of epithelial cells was not demonstrated and the remaining epithelial layer was coherent, degeneration is presumed The fluid contained lipoid that cannot be accounted for except by disintegration of epithelial cells. Eggston and Wolfe[10] have attributed bleb formation to hydropic degeneration or edema. This alone does not account for the formation of lipoid blebs. Since lipoid-containing, intra-epidermal blebs are not discussed in the textbooks on histopathology of skin,[11,12] they are apparently unique to the umbo Primary degeneration is merely inferred since the etiology remains obscure Additional investigation may provide more definitive data

SYMPTOMS

Significant symptoms are strikingly absent When there is a complaint referable to such an ear, it can almost be assumed that the bleb is incidental This observation has been borne out by Lathrop[5] and Arnold[9] Four patients in this series had co-existing deafness Two had clinical otosclerosis, bilaterally, and had been under observation by one of my associates for years Each of the other two patients had a long history of perceptive deafness Not one of the patients noted any change in hearing acuity in relationship to the blebs One patient complained of vertigo Incision into the bleb did not alter the vertigo

A few patients complained of pain in the ear In two of these, the blebs were bilateral, but the pain unilateral In another, the pain was of dental origin and did not subside after the bleb was evacuated but disappeared after the extraction of a carious molar In no instance was there any sign of otitis media or myringitis The benign nature of these blebs is indicated by the fact that they contain lipoid, show no evidence of inflammation, even microscopically, and often persist for several weeks

It is conceded that a large mucosal bleb could cause a conductive loss of hearing Only 2 mm separate the tip of the manubrium from the promontory, and a bleb that exceeded 2 mm in diameter might produce the sensation of stuffiness and egophony as described by Wible[6] This relationship should be remembered, since a mucosal bleb could explain an otherwise obscure conductive deafness, and the symptoms could easily be relieved by incision into the bleb A large epidermal bleb, by virtue of its mass, might be expected to produce symptoms, but neither type of bleb has been responsible for symptoms in any of my patients *

DIFFERENTIAL DIAGNOSIS

The diagnosis of an umbo bleb should present no problem They are common and, once recognized, will be noted with increasing frequency External (epidermal) blebs should be easily differentiated from internal (mucosal) blebs The only

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* Since this manuscript was prepared a patient with a large mucosal bleb has been seen Her complaints as hypothesized above were those of stuffiness in the ear and egophony Relief was obtained promptly after the bleb was incised

conditions with which they may be confused are cysts and myringitis bullosa, both of which are rarely seen at the umbo The fluid within external umbo blebs is oily rather than serous or hemorrhagic, further, no symptoms have been observed that could be definitely related to the formation of lipoid blebs at the umbo

TREATMENT

It is questionable whether or not any treatment is necessary At most, simple incision into the bleb is all that is indicated, and this should be reserved for patients with definite complaints Incision can be expected to eliminate the bleb but not necessarily pain, tinnitus, vertigo, or deafness Friedman[7] was unable to exhibit a significant change in hearing after he dispersed the fluid by the application of pressure with a cotton tipped applicator

CONCLUSIONS.

Non inflammatory umbo blebs containing lipoid material were the most common vesicular lesions of the tympanic membrane in this series Since they are asymptomatic, the finding was usually incidental to doing a complete examination The lack of symptoms probably accounts for the fact that most otologists are unfamiliar with their existence The significance of these blebs at the umbo remains unknown at this time.

SUMMARY

Blebs at the umbo were found in 66 ears in 24,000 examinations, an incidence of 1 364 The external blebs are smooth, rounded glistening intra-epidermal collections of clear, oily fluid and were observed much more frequently than mucosal blebs in this series Definite symptoms were significantly absent in all cases It is suggested that these noninflammatory blebs represent a localized degenerative process resulting in the dissolution of epithelial cells The etiology remains to be determined

Acknowledgment My sincere appreciation is expressed to Dr Paul Kimmelstiel for his description of the pathology and for assistance in determining the nature of the vesicular fluid

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STUDIES ON PER STIMULATORY ADAPTATION IN VARIOUS GROUPS OF DEAFNESS*

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INTRODUCTION

Studies in auditory fatigue have hitherto been concerned mainly with the determination of the amount of threshold shift measured shortly after cessation of a stimulus The magnitude of loss in loudness level experienced during a continuous stimulus has only recently aroused attention in experimental literature. This loudness change was termed by Hood[8] per stimulatory fatigue or adaptation, both terms being used interchangeably

Hood's experiments, so lucidly described, brought out one important clinical implication It seemed that most of the patients suffering from Menière's disease with complete recruitment experienced an abnormally large loudness level loss during three minutes' stimulation This finding suggests that the measurement of per stimulatory adaptation might have some use as a method of classifying hearing impairments into clinical subgroups, in about the same fashion as the recruitment tests proper are presently used

It has been reported earlier that the recruitment phenomenon is accompanied with a poor articulation score The loss in speech discrimination, however, depends considerably on the specific test items and the language used Hirsh, Palva and Goodman[7] demonstrated with American PB words that a hearing loss for speech of more than 20 db in recruiting ears parallels a poor discrimination ability In Finnish test material[11] speech function was not seriously impaired until a 40 db hearing loss at threshold was exceeded. It also appeared that a slight hearing loss of less than 25 db did not affect the discrimination ability

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From a study[7] dealing with difference limina to intensity it became apparent that difference limina, measured by a two-tone comparison, did not differ significantly in the various subgroups of deafness, although in speech function there were no doubt large differences between these groups

We pointed out that, for good speech intelligibility, many factors probably are important Ability to detect rapid changes in intensity, in fundamental frequency, and in spectrum. One would presume also that the ear would neither fatigue so easily as to render speech sounds too weak in loudness nor become temporarily fatigued by the louder speech elements rendering the soft formants inaudible

In an earlier paper[13] I tried to imitate the possibly fatiguing effect of loud vowels upon weaker consonants, by introducing into the ear an interrupted white noise and in the presence of this noise measuring the thresholds for pure tones It is quite clear that the audibility of pure tones and the intelligibility of speech are things apart

It was intended primarily, however, to ascertain whether the interrupted noise would show the effect of per-stimulatory fatigue upon the tones At the highest available interruption, 12 per second, this was not the case When speech and noise were introduced simultaneously into the same ear, the perceptively deaf ears were usually severely affected, but the conductively deaf ears were not affected There was no clear difference between the recruiting and non-recruiting perceptive groups, the speech score being frequently lowered in both

It may be noted here that a differentiation between the perceptive subgroups on the basis of speech tests alone cannot always be successfully done Although the non-recruiting ears usually show moderately good speech discrimination, there are always ears showing poor intelligibility In connection with acoustic tumors Schuknecht and Woellner's[16] hypothesis was, actually, that a certain minimum number of functioning nerve fibers is one of the essential requirements for good speech function It seems evident that in seeking to explain a poor articulation score, one is dealing with so many different factors that one explanation will not suffice

This study has been carried out in an attempt to determine the changes in loudness level during a continuous stimulus in various groups of deafness and to relate these changes to the recruitment phenomenon Secondly, the changes in adaptation are compared with the data of speech intelligibility to learn whether or not these two phenomena can be correlated

BRIEF REVIEW OF EARLIER STUDIES

One of the first to study the development of a per-stimulatory adaptation was de Maré.[10] He obtained a loudness balance between two pairs of 475 cps tones of 0 4 seconds duration alternately in the ears. These tones followed one another after an interval of 2 7 seconds indefinitely When the free interval in the test ear was substituted for a 500 cps tone of the same 88 db intensity, and another balance with the control ear was obtained there was a loudness level loss of about 30-40 db

If the fatiguing tone of 500 cps was followed by a pause of 0 7 seconds before the balancing pair of tones appeared, then a loss of only about 5 db in the loudness level was observed It was pointed out by Hood[8] that the first procedure is essentially comparable to his own per stimulatory adaptation experiments, as the two frequencies mentioned were so close to each other In the second experiment the silent period of 0 7 seconds was sufficient to allow the normal on-effect to appear and result in about equal loudness level between the ears

Hood's monograph[8] on auditory fatigue describes the first detailed and well-controlled experiments on per stimulatory adaptation placing it in a distinct relationship with neuro physiological phenomena in general Hood's technique in normals was as follows A continuous tone was given to the test ear and, from time to time, a balancing tone of 10 seconds' duration was led to the other ear

The balance, as judged by the observer was automatically registered on a graph The measurements were made with tones of 500, 1000 and 2000 cps at 20 to 100 db sensation levels Hood concluded that per stimulatory fatigue develops at a fairly constant rate and quite slowly, reaching a maximum in about three minutes, and increasing with the sensation level The tests were carried out, using four normally hearing subjects It appeared that the amount of per-stimulatory adaptation was individually different, but generally about 30 db at 80 db sensation level (see Figs 3-5)

In hard-of-hearing subjects, and also in some normal ears, another procedure was used The subject was given a continuous tone of 70 db above normal threshold in both ears, and he was instructed to control the attenuator of one (better) ear to maintain a loudness balance between the ears

Hood mentioned that in 25 cases of Meñière's disease, 20 showed abnormal fatigability in the diseased ear, which manifested as a decrease in the level of the balancing tone by 10 to 50 db In conductively deaf persons, and in normals, the balance tracing pursued a steady course without fatigue during the three minutes of the test

The two different techniques of measuring per-stimulatory adaptation bear an important implication If a fatiguing tone is responsible for about 30 db loudness level loss in the normal ear when the comparison is made with an *interrupted* balancing tone, then when both the fatiguing and the balancing tone are *continuous*, the loudness level loss will still be present without anything present to indicate this on the self-recording audiogram

If, in a recruiting ear, this latter type of adaptation test gives a reduction of say 40 db, we should be able to measure a considerably larger loss in loudness level with an interrupted balancing tone The validity of this implication was not tested by Hood

Hood's experiments suggest that after the first three minutes' stimulation there is no noticeable change in the loudness sensation, but a discharge at a steady rate will follow, this finding is also supported by the action potential measurements of Derbyshire and Davis[1] in the auditory nerve of a cat Van Dishoeck's citation of van Gool's work,[2] on the other hand, shows that the loudness adaptation may not be complete until after six to eight minutes' stimulation

TESTING PROCEDURE AND APPARATUS

Air and bone conduction audiogram were measured in the usual manner In these tests both ears were covered with air conduction receivers, and masking with a thermal noise was employed according to the principles described earlier [12] The source for pure tones was a Peters SPD 2 audiometer with PDR 10 earphones, which was calibrated in terms of the sound presure level at 60 db reading and relative to a fixed input of 0 1 volts at various frequencies The values relative to the zero level of the audiometer are presented in Table I

TABLE I.

SOUND PRESSURE LEVELS OF THE PETERS SPD-2 AUDIOMETER AT 0-DB HEARING LOSS (DB ABOVE 0 0002 MICROBAR)

Frequency	125	250	500	1000	2000	4000	8000
	55	43	25	17	15	15	18

Recruitment testing was done by applying tones of 1 5 seconds' duration with an interval of 0 5 seconds alternately to the ears according to the principles of Fowler's balance test. If this were not possible Reger's monaural test was used

Speech reception thresholds were measured with the Finnish Test List No III, containing easier words of trochee type, recorded one by one by decreasing the intensity manually 5 db after five successive words until the subject did not hear a single word correctly Speech discrimination was measured with Test Lists I or II containing more difficult trochee type words using 80 words for each ear The intensity for discrimination was kept, as far as possible 40 db above the SRT [11]

At the beginning of these studies the apparatus for measuring per stimulatory adaptation was quite simple The two earphones in a headband were fed separately by two audiometers, a Peters SD 2 and an Amplivox M 60 The differences in calibration between these two and the testing audiometer Peters SPD 2 were taken into account

A continuous tone was given into the test ear and a balance was obtained for manually interrupted test tones, about two seconds long, in the balancing ear This balance was obtained right at the beginning of a three minutes' fatigue period and then after one, two and three minutes' stimulation

For about one-third of the hard-of-hearing subjects a Bekesy type self-recording audiometer was available This audiometer has two separate channels in ordinary use One for the tones and another for the masking noise In the first channel the tone is controlled automatically in 1 db steps over an intensity range of 140 db at a rate of 2 3 db per second as the subject presses a button In the second channel the stimulus can be controlled manually by the operator in 5 db steps These two channels can also be fed by a separate sound source, and the intensity controlled before the attenuators with a Pegel voltmeter

For testing per-stimulatory adaptation, a Peters SPD-2 audiometer was used to feed both channels simultaneously with a pure tone that could be controlled in both earphones as described above A block diagram of the apparatus is shown in Fig 1

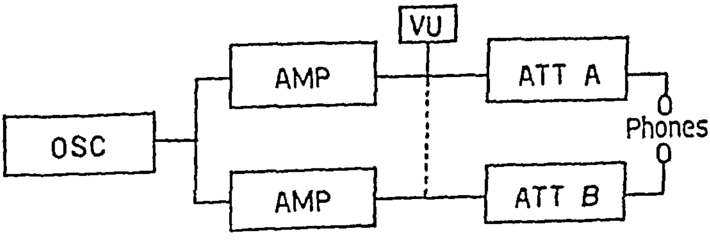

Fig 1 Block diagram to illustrate the arrangement of equipment for measuring per stimulatory adaptation The tone intensity is controlled in both channels with a VU-meter before the attenuators The fatiguing tone is led through attenuator B where it is controlled manually in 5 db steps by the operator the balancing tone is led through attenuator "A where it is controlled automatically in 1 db steps by the subject

The technique described for the simpler apparatus was used, the sole difference being that the balancing tone was kept *continuous* for 15 seconds, and the writing apparatus recorded its excursions automatically during this loudness match In a few cases the tones in both ears were kept continuous during the entire testing period, and a continuous tracing from the balancing ear was obtained

DIFFICULTIES IN THE DETERMINATION OF LOUDNESS ADAPTATION

A proper loudness balance test is made by comparing two tones of equal duration presented alternately at a short interval to both ears On the other hand, many audiometers are equipped with a loudness balance control where the same tone is delivered simultaneously to both ears, and an attenuator allows a reduction in the intensity of the tone in one earphone A position for the attenuator that the subject feels corresponds to a sensation of equality between the ears is sought.

The difficulties in this type of loudness balance test were pointed out successfully by Hirsh[6] When a tone is simultaneously heard in both earphones, the loudness comparison is rendered uncertain because the tones have an unitary localization, usually at the center of the head In a sense, one is substituting a judgment of central localization for a loudness balance judgment. There will probably be some differences between the various frequencies, the judgment ought to be easier in the high tones because the differences in intensity are more important for localization at these frequencies, whereas for low tones the difference in the time of arrival (or phase) is more important.[16]

The measurement of per-stimulatory adaptation must be made in the same fashion. A continuous tone is introduced into the test ear and either manually or automatically with a recording apparatus a balancing tone is brought for a short time into the control ear The fatiguing tone in the test ear cannot be discontinued without seriously interrupting the experiment, and therefore the test loses in accuracy as compared with binaural alternate balance.

A preliminary experiment, therefore was performed on normally hearing persons to test the magnitude of the variations in intensity for tones judged equal in loudness A tone of

60 and 80 db sensation level was given to both ears at 4000, 2000, 1000 and 500 cps in the order mentioned, to avoid overlapping fatigue,[17] and the subject was instructed to maintain equal loudness in the ears

The recording of the variability of the tone intensity in the balancing ear was made automatically with a Békésy-type audiometer during a one-minute test period at each frequency The width of the excursions did not differ appreciably at the four frequencies In a few instances it was about 15 db, but generally it seemed that a width of 10 db was a fair average (see Fig 2)

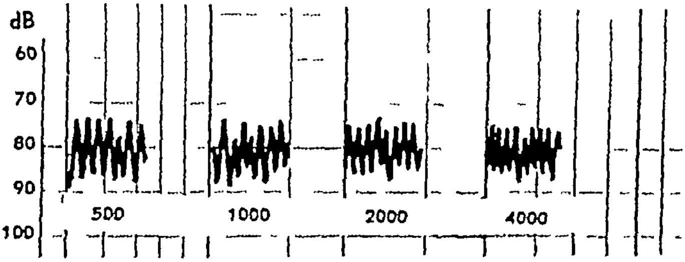

Fig 2 Simultaneous bilateral loudness balance test during a continuous stimulation of 1 minute at 80 db sensation level The width of the excursions expresses the intensity range that is needed to make the balancing tone in one ear to sound alternately softer and louder than the 80 db steady tone in the other ear

Subjectively, however, judgment was mostly felt to be easiest at 4000 cps where the tones could be heard separately in the ears The more the frequency was lowered, the more central was the localization, and the tone seemed to shift, not in the ears but in or above the head

For an average listener, therefore the accuracy of a simultaneous bilateral loudness balance test seems to be around ±5 db and definitely less than ±10 db When this is applied to a test for per-stimulatory adaptation, there should be an equal distribution of the values around the initial balance tracing, providing no adaptation occurs In the case of a loudness loss due to adaptation, the subsequent tracings should be lower than the initial balance value A loss of 10 db or more would be indicative of a real loudness change and not due to an experimental error

PER STIMULATORY ADAPTATION IN NORMAL EARS

At the beginning of this work Hood's[4] figures for the amount of auditory adaptation were taken as a reference, and then proceeded directly to testing hard-of hearing patients It soon appeared, however, that the amount of adaptation obtained in deaf subjects differed so much from Hood's figures that a validation work on normal material seemed also necessary This was done entirely with the Békésy audiometer The subject himself controlled the intensity in the balancing ear, and the recording was made automatically

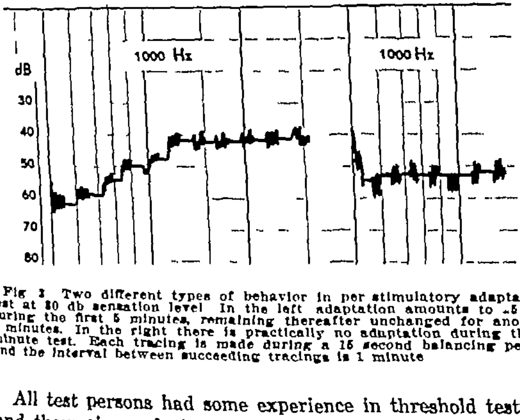

Fig 2 Two different types of behavior in per stimulatory adaptation test at 80 db sensation level In the left adaptation amounts to 25 db during the first 5 minutes, remaining thereafter unchanged for another 5 minutes. In the right there is practically no adaptation during the 7 minute test. Each tracing is made during a 15 second balancing period and the interval between succeeding tracings is 1 minute

All test persons had some experience in threshold testing, and their air conduction curves measured on different days showed little variation. Two sensation levels, 60 and 80 db (see Figs 3, 4) were used The subject was first given a tone at 60 db level to both ears and he was requested to maintain a balance between the ears After 15 seconds the tone in the balancing ear was discontinued, and the tone in the test ear was kept continuous for some minutes After each minute a 15 seconds balancing period was introduced, which re-

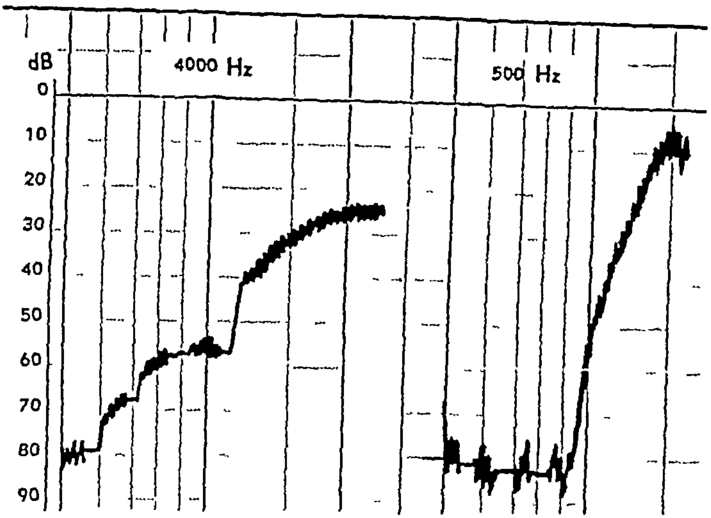

Fig 4 Two different types of behavior in per-stimulatory adaptation test at 80 db sensation level In the left, adaptation amounts to 25 db In the right there is no adaptation loss at all during 3 minute testing period The post stimulatory threshold tracing does not reach normal level during 2 minute recovery period at the right the recovery to normal values is rapid

corded aumatically the development of per-stimulatory adaptation For each subject, only one sensation level at 4000, 2000, 1000 and 500 cps was used during one day to make sure that there was no remaining adaptation from previous tests

TABLE II

ADAPTATION LOSS IN NORMAL EARS AFTER CONTINUOUS STIMULATION OF 4 MINUTES AT 60 DB AND 3 MINUTES AT 80 DB SENSATION LEVEL

Frequency	Sensation Level	Average Intensity Level	Mean of Adaptation Loss	Standard Deviation	Number of Subjects
500	60	78	6 4	9 7	9
	80	98	4 8	8 4	12
1000	60	74	8 6	6 1	15
	80	94	2 2	6 4	12
2000	60	73	4 7	5 3	9
	80	93	4 8	7 5	12
4000	60	75	5 5	6.2	9
	80	95	3 9	9.9	12

The results for normal subjects are presented in Table II and graphically in Fig 5 It is apparent first, that the individual results varied within rather wide limits Some showed considerable adaptation of the order of 20 db, in others there was no loudness loss at all and the balancing tone showed variations of the order of ±5 db around the value of initial balance. This is quite in accordance with the assumption made earlier for cases, in which no per stimulatory loudness loss develops Second, it can be seen that the figures for the two different sensation levels are essentially the same, *viz* the loudness level loss does not increase with increasing intensity

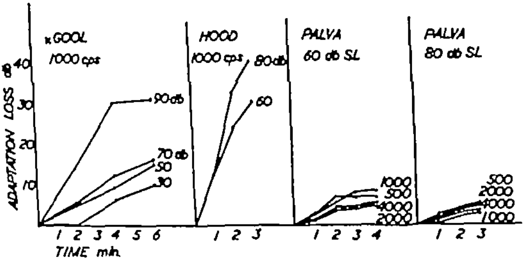

Fig 5 Adaptation loss as a function of sensation level V Gool s figures are drawn from van Dishoeck s[3] Fig 8 where the term 'loudness in db" is interpreted as to mean sensation level Hood s[4] curves are reproduced from Fig 15 There is a substantial difference between Hood s and the two other studies at lower sensation levels during a 3 minute stimulation.

It must be pointed out that these figures cannot be considered sufficient for a detailed study of per stimulatory adaptation in normal ears For that the material is too limited, and the range of different sensation levels is not adequately covered but for the purpose of this paper they are representative of normal values as compared with values for hard-of-hearing ears at the same levels

Large individual variations in per-stimulatory adaptation were also observed by Hood, who reported a difference of 26 db between two subjects at 100 db sensation level. In [illegible] of the four ears studied by him the loss in the loudness [illegible] at 80 db sensation level was between 20 and 30 db for [illegible] 2000 cps tones It is probable that a larger sample of [illegible] would also have disclosed subjects with a minimal loudness change

The standard deviation in each group (see Table II) shows quite large values, which suggest that a loudness level loss of the order of 30 db (more than 3 SD's) is indicative of a really abnormal sensitivity to continued stimulation

PER-STIMULATORY ADAPTATION IN DEAF SUBJECTS

The patients studied for per-stimulatory adaptation were divided into clinical groups on the basis of the criteria commonly used The conductive *group includes unilateral cases* of chronic middle ear disease with good bone conduction and without recruitment, and also some otosclerotic ears The second group, that of perceptive deafness with recruitment, includes patients with Méniere's disease, cochlear degeneration or acoustic trauma All of them showed lowered bone conduction and complete recruitment in Fowler's test The cases of equally low air and bone conduction without recruitment and without any signs of middle ear involvement[14] were included in the third, perceptive non-recruiting group The results of speech discrimination were not used as diagnostic criteria in this study

The conductive group comprised 18 ears In these cases a fatiguing intensity of 80 or 100 db above normal threshold was used to stimulate the impaired ear for three minutes The sensation level, however, could not always be raised to the 80 db level because the conductive component reduced the intensity in the inner ear

In the recruiting perceptive group 51 ears were tested, mostly at a sensation level of 80 db above normal threshold In more severe cases a 100 db level was also used (four ears) Because of the positive recruitment phenomenon the loudness level in these ears should be comparable to normal or nearly normal cases

The perceptive non-recruiting group consists of only nine cases, mostly tested at a sensation level of 80 db, sometimes 100 db above normal threshold The loudness level in these ears should be comparable to those in the conductive group

The loudness level loss due to per stimulatory adaptation is presented summarized in Table III One can see that the loss in the conductive and non recruiting perceptive group is of the same magnitude, and does not differ appreciably from the normal values in Table II In the perceptive recruiting group, however, there are some ears, in which the loudness loss due to adaptation is definitely larger than could be expected, although the change in many cases is comparable to that of normal

TABLE III

MAGNITUDE OF ADAPTATION LOSS AND ITS OCCURRENCE IN VARIOUS GROUPS OF DEAFNESS

Type of Hearing Loss	Adaptation Loss in db											Total Number of Cases
	5	0	5	10	15	0	25	30	35	40	45	
Conductive Group		5	4	6	2	1						18
Recruiting Nerve Group	1	11	11	13	5	2	1	3	1	1	2	51
Non recruiting Nerve Group		1	3	4		1						9

It was pointed out earlier that in Finnish speech tests a lowered discrimination score is usually associated with cases of recruiting perceptive deafness showing a threshold loss of 40 db or more Table IV is presented to illustrate the relation between low discrimination score and adaptation loudness loss. It includes all cases of poor speech intelligibility with detailed audiograms between 500 to 4000 cps It can be seen that among these 11 cases there are four with 30 db or more loss in loudness level, in the remaining seven cases stimulation for three minutes did not cause abnormal change in the loudness levels

The three cases of Table III that show 30 db or more loss in the loudness level include two in which the threshold loss was less than 40 db In one case with a 35 db loudness level loss at 4000 cps, the threshold was 50 db below normal but the other frequencies showed a loss only around 20 db in the speech range Speech intelligibility was normal in all these cases

TABLE IV

CASES WITH LOWERED SPEECH DISCRIMINATION RELATED TO ADAPTATION LOSS

Case	Threshold Audiogram				Adaptation Loss				Speech Discrim Per Cent	IL of the Fatiguing Tone (re 0-level)	Diagnosis
	500	1000	2000	4000	500	1000	2000	4000			
SA ..	60	70	55	55			0		3	80	Méñière
OP ..	65	65	50	45	0	5	5	5	3	80	"
LK	25	75	65	60	15	5	10	15	0	90 80	"
OH	40	40	40	20		15			61	80	Ac trauma
SV	50	55	40	40	10	10			60	80	Méñière
MH ..	60	70	65	55		30			30	90	"
LH ..	45	55	50	65	10				68	80	Cochlear deg
MM	55	65	55	45			15		70	80	Méñière
AM ..	15	50	50	30		10	10		71	90	"
II .	70	70	55	75			30		68	80	"
MA ..	60	60	30	25		20			22	90	"

In the conductive and in the non recruiting perceptive groups speech intelligibility was normal in all cases

Two cases only were tested with a continuous tone in both ears during the whole testing period These cases showed about 5 db loudness adaptation in the previous test with interrupted test tone in the balancing ear The tracing obtained during continuous stimulation in these recruiting ears showed essentially the same result, although the patients complained that judgment was more difficult.

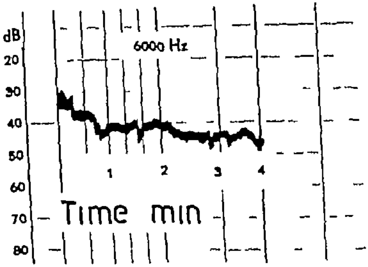

Fig 6 A continuous threshold tracing at 6000 cps during 4 minute testing period. The threshold is lowered by about 10 db and the width of the excursions remains the same or is somewhat reduced

In four cases a continuous threshold tracing was recorded during a four minute period at a frequency showing positive recruitment. The tracing had an even course in one ear one showed deterioration of threshold by 5 db and two a further loss of 10 db (see Fig 6) No increase in the width of the excursions was noted In the case with 10 db loss on the contrary, the threshold variability decreased clearly This is in opposition to the view held by Dix and Hood.[3] Studies of this question are to be continued with a greater number of subjects

DISCUSSION

The figures for per stimulatory adaptation in normal subjects suggest that the development of adaptation is not related to the intensity level, as far as the two sensation levels of 60 and 80 db *are concerned* *This finding* is in accordance with van Gool's[4] results, but differs from the opinion of Hood, who regards the increasing intensity level as an important parameter for an increased per-stimulatory adaptation

Hood feels that, contrary to post-stimulatory fatigue, there is no critical intensity for an abnormally large increase in per-stimulatory adaptation Van Gool's results, on the other hand, suggest that there is a traumatizing intensity after which the per-stimulatory adaptation increases disproportionately to previous levels This level probably is higher than the 90 db sensation level, although no precise intensity scale can be found in the text cited by van Dishoeck

At 80 db sensation level a 10 db adaptation loss would mean a loudness loss from 25 to 12 sones, and a 20 db decrease correspondingly to 6 sones This would already be a two- or fourfold decrease in loudness One would suspect that normal adaptation could hardly be responsible for more loss than this

It was pointed out earlier that, according to Hood's results, there should be quite large adaptation changes He considers that a loss of about 30 db is obtained in normal ears with an interrupted balancing tone at 80 db sensation level In hard-of-hearing cases a loss in loudness level of 10 to 50 db was demonstrated with a continuous balancing tone

This latter technique does not take into acount the adaptation which, logically, is bound to occur in the continuously stimulated balancing ear Providing the losses in the loudness levels are simply additive, adaptation values between 40 and 80 db ought to be obtained with an interrupted balancing tone, because no interfering adaptation would develop in the balancing ear This amount of loss would mean that in many cases the tone would almost vanish from the tested ear during a three minute fatiguing period

The technique with an interrupted balancing tone in the good ear did not reveal adaptation losses greater than 45 db in this series On the basis of the standard deviation in Table III, one is inclined to consider adaptation losses of 30 db or more abnormally large These occurred only in the group of recruiting perceptive deafness, totalling 7 or 14 per cent. In only one case did the patient feel that the test tone nearly vanished from her ear during the three minute fatiguing period

The findings reported by Hood,[4] Hallpike and Hood,[5] and Dix and Hood[6] are confirmed in a way The results differ considerably, however, in the magnitude of the adaptation as well as in the percentage of recruiting subjects in whom this phenomenon was found It seems that the role of the loudness level loss has hitherto been overestimated, and that conclusions have been drawn somewhat prematurely, however, when there is an abnormally large loss in loudness level it seems to be associated with recruiting perceptive deafness

Speech discrimination and abnormally large loudness adaptation do not seem to be related Poor speech intelligibility can be found in cases of perfectly normal adaptation loss This is understandable when we think of the very short time needed for one word to be "on" Although the patients do not repeat the words correctly, they often spontaneously remark that they are quite loud, furthermore, the Finnish records do not contain any introductory phrases, but the words follow each other at intervals of five seconds The recovery period for short time fatigue should, therefore, also be sufficiently long

It seems that the decrease in loudness for speech sounds does not by any means explain poor intelligibility Nor is the temporary fatiguing effect of loud vowels upon weaker consonants supported by a comparison between Finnish and American test material In Finnish words, the role of the vowels is clearly more important than in the PB words, yet the former are more easily understood

Licklider and Pollack's studies[9] with clipped speech waves, even when reduced to parallel straight lines, resulted in a good articulation score. This has cast considerable doubt on the theories of disturbed loudness values at various frequencies as the sole cause of poor speech intelligibility, however, if the clipper was preceded by a low-pass filter (integrator), suppressing the spectrum 6 db per octave, a large discrimina tion loss followed This situation might be comparable in a way to the effect of the recruitment phenomenon when there is, in addition to general distortion, a high preponderance of loud vowels, whereas the consonants may remain disproportionately weak near the auditory threshold

SUMMARY

A short review of papers on per-stimulatory adaptation is given, and some factors affecting binaural simultaneous loudness balance judgment are pointed out Results are reported in a group of normal subjects, in which the adaptation loss was measured at 60 and 80 db sensation level at 4000, 2000, 1000 and 500 cps The loudness level loss, measured after three minutes continuous stimulation, was on an average less than 10 db

In 18 cases of conductive deafness and in nine ears with non-recruiting perceptive deafness, the adaptation loss was comparable to normal values In recruiting perceptive deafness (51 ears) an abnormally large adaptation loss (30 db or more) was found in 14 per cent It is concluded that abnormal loudness adaptation is not related to poor speech discrimination, and its occurrence is not so frequent as assumed earlier When it does occur it seems, however, to be associated with recruiting perceptive deafness

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DIAGNOSIS AND TREATMENT OF PAROTID CALCULI

JAMES R BLAIR, M D,

Denver, Colo

Parotid calculi are uncommon, occurring more often in men than in women, and rarely attaining the size of calculi found in Wharton's duct In contrast to the latter they are not often palpable

Due to local tissue reaction and to overlying structures, parotid stones are as a rule difficult to visualize by ordinary X-ray technique Uric acid stones, too, since they are not radiopaque, pose a singular diagnostic problem which can be solved only by sialography

Parotid calculi most often lodge in the masseteric portion of Stenson's duct, at or near the junction of the main and accessory ducts This fortuitous circumstance makes some of these calculi amenable to conservative treatment, by extraction or lithotrite, thus obviating the unsightly scar resulting from external surgery

The history of parotid calculi is characteristic Intermittent, painful pre-auricular swelling aggravated by highly seasoned foods and relieved by a gush of foul, purulent or inspissated saliva, is pathognomonic of ball-valve parotid duct *obstruction*

In contrast to infectious parotitis, the glandular swelling from the stone is not always symmetrical, in fact, only certain portions of the gland, especially the accessory lobe, may be enlarged, thus giving rise to the diagnosis of tumor formation *Added evidence may sometimes be gained by probing the* duct

Sialography has proven to be a valuable aid in visualizing and localizing non-opaque uric acid stones In addition, sialography demonstrates accurately the amount of damage which inevitably results to the gland parenchyma from back pressure

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Editor's Note This ms received in Laryngoscope *Office* and accepted for publication July 5 1955

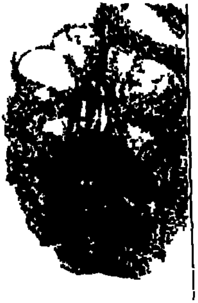
The conservative treatment of parotid calculi by direct intraoral extraction, or by lithotrite, is not mentioned in the literature This method has been successfully employed on a number of occasions If the stone is located in the intraoral portion of the duct or even in the anterior portion of the masseter segment, the problem of removal is comparatively simple The duct is first widely dilated by means of No 5 ureteral catheters left *in situ* for several weeks With a small Hartman forceps the stone can then be directly extracted, or, if necessary crushed and extracted piecemeal

Radical treatment consists of exposing Stenson's duct by a horizontal incision to guard against injury to the nerve After extracting the stone the duct is repaired by fine silk sutures, and a catheter is left *in situ* for as long a time as seems feasible By passing the end of the catheter through the eye of a medium sized skin clip and anchoring this to the buccal mucosa it causes no discomfort

CASE REPORTS

Case 1 Mrs M an elderly woman with a long history of bilateral intermittent swellings of the parotid Examination shows a free flow of pus from both parotid ducts Patient refused surgery

Fig. 1



Fig

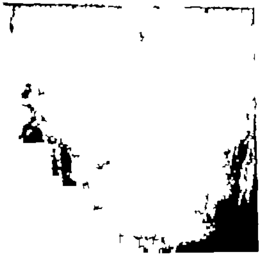


Fig 1 Showing size and location of parotid stone.

Fig Sialogram showing destruction of gland parenchyma

Case 2 J P 28 year old female Intermittent painful right parotid swelling for 2 years Recurrent bouts of infection controlled by antibiotics X rays failed to show stone Uric acid stone visualized by sialogram

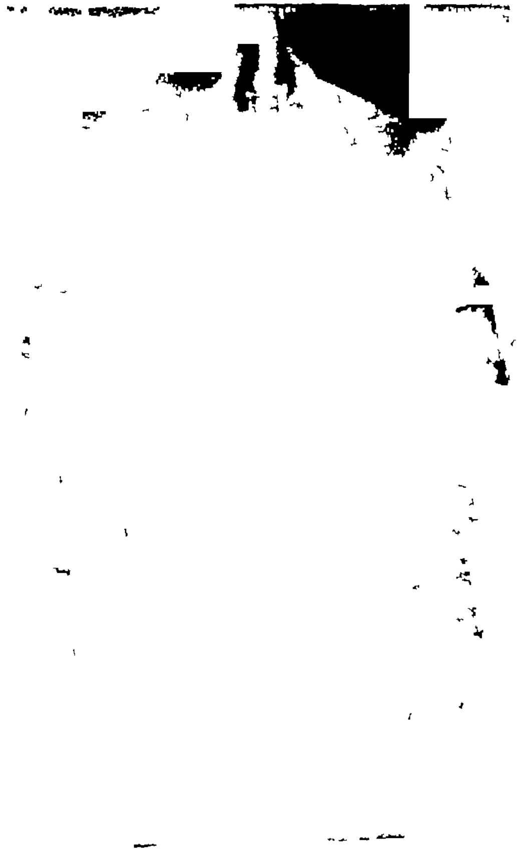


Fig 2 Sialogram of uric acid stone

Treatment Duct dilated by means of catheters and stone removed intraorally with Hartman forceps

Case 3 Male 51 years of age History of painful parotid swelling on the right for several years.

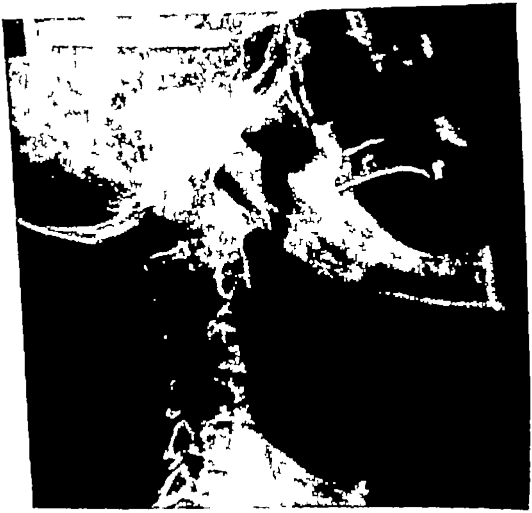


Fig 4. X ray showing catheter in situ

Treatment Stone removed by external incision.

Case 4 36 year old male, whose complaint was a continuous discharge of saliva *from a wound in the right cheek, which followed an operation* for "tumor" several weeks previous Examination shows a vertical scar in the center of which is an evident salivary fistula

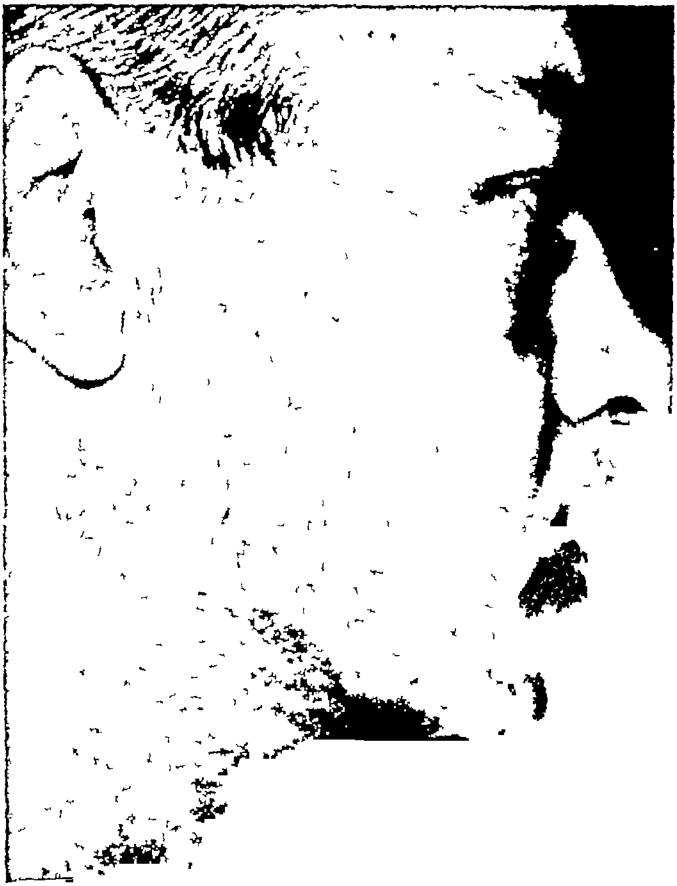


Fig 5 Post-operative Fistula healed

Operation Horizontal incision Stone which was situated at the junction of the main and accessory ducts removed Fistula repaired Indwelling catheter Healing by first intention

Comment Pathological report of "tumor" originally removed was "Normal Parotid"

Case 5 32-year-old male History of intermittent painful swelling of the left parotid for five years. Operation at angle of the jaw for "tumor" five years previous. Second operation on duct two years ago which failed to reveal stone.

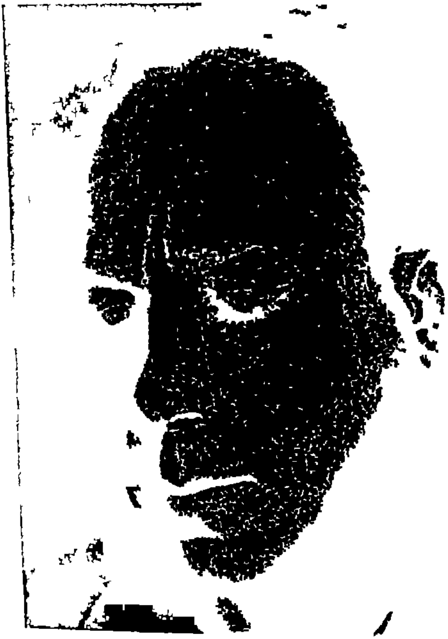


Fig 6 Preoperative showing scar of previous operation on duct and characteristic enlargement of accessory gland.

Operation Calculus found at the junction of the main and accessory ducts Calculus removed and stenotic portion of duct excised Catheter inserted

CONCLUSIONS

Parotid calculi are difficult to visualize by ordinary X-ray technique

Uric acid calculi may readily be visualized by sialography

Parotid calculi may simulate tumors, especially with enlargement of the accessory lobe when the stone is located at the junction of the main and accessory ducts

Calculi situated in the intraoral or anterior portion of the masseter segment may sometimes be removed intraorally after wide dilatation of the duct by means of catheters

Catheters can be worn indefinitely, if fixed to the buccal mucosa by means of skin clips

227 Sixteenth Street

MEDICAL NEWS

Summit, New Jersey, Sept. 8—MEDICAL NEWS, the first newspaper exclusively for the medical profession, will begin publication on September 12, it was announced today by T F Davies Haines, president of CIBA Pharmaceutical Products Inc. of Summit, New Jersey CIBA will distribute the eight-page tabloid size newspaper free of charge to physicians every other week.

Published for CIBA by Medical News Inc., the new publication will provide the busy physician with brief and authoritative news and feature articles on current medical developments here and abroad The editorial content of the newspaper will be determined independently of CIBA'S interest as a pharmaceutical manufacturer

Blake Cabot will serve as executive editor of MEDICAL NEWS A graduate of Harvard University, Mr Cabot is the author of *The Motion of the Heart,* a book on cardiovascular research. He was previously director of publications for the Greater New York Fund and has performed public relations work for the American Heart Association During the past 15 years, Mr Cabot has written many articles on medical research and public health

"Reports from special correspondents in the United States Europe, Latin America and Asia will appear regularly in MEDICAL NEWS," states Mr Cabot "These reports," he adds "will cover clinical Medicine research medical education public health, medical economics and legislation directly affecting the physician"

Accounts of major medical and scientific meetings, now published under the title of CIBA REPORTS, will be incorporated into MEDICAL NEWS Other regular features will include a European news letter a review of recently published books on medicine and health, profiles of outstanding physicians and medical scientists news from medical institutions and medical economics

MEDICAL NEWS is the latest service provided by CIBA for the medical profession The CIBA CLINICAL SYMPOSIA a magazine containing original scientific papers by leading medical professors and practitioners with illustrations by the well known medical artist, Frank Netter, M D is also distributed free of charge to practicing physicians in the United States *The CIBA Collection of Medical Illustrations*, published in three volumes, has been made available to physicians at cost. CIBA is also sponsoring a half-hour documentary television program, "Medical Horizons," which will be presented for 26 weeks on the ABC-TV network beginning September 12

II INTERNATIONAL CONGRESS ON ALLERGOLOGY

The II International Congress on Allergology will be held in Rio de Janeiro, November 6-13, 1955 The most outstanding authorities on the matter will be present at this meeting, with a view to submitting and considering the following official subjects Histamin and Mechanism of the Allergological Reactions—(histamin, its metabolism and its rôle on the allergology, histamin releasers Drug Allergology, including the antibiotics) Immunology and Allergology (chemical compositions of the antigenes and antibodies, immunological quantitative technics applied to allergology) Asthma (physiopathology, death through asthma, climatic asthma) Dermatological Allergology (including industrial and contact dermatitis) Allergology and Verminosis Allergology and Leprosy Allergology and Tuberculosis Allergology and Hormones

Prior to the opening of the Congress, on November 3-5, an international and intensive course on allergology will be held, in which about thirty famous scientists will participate The Congressists, by addressing themselves to the Congress Secretary-General, will be considered as registered in this course All other interested parties (physicians or medical students) are requested to register their names, in due time, at the General Secretariat

Registration fees U S $15 00 Accompaniers U S $6 00 each

For further information and registration, please apply to

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COURSE IN RECONSTRUCTIVE SURGERY OF THE NASAL SEPTUM AND EXTERNAL PYRAMID

Under the joint sponsorship of the Departments of Oto-Laryngology of the L S U School of Medicine and Tulane School of Medicine a course in Reconstructive Surgery of the Nasal Septum and External Pyramid will be presented in New Orleans March 10 17 (inclusive), 1956

The course will be given with the cooperation of the American Rhinologic Society and under the direction of Dr Maurice H Cottle

The assisting guest faculty will include the following Drs Walter J Aageson, Fred W Beck, Max Bornstein, James Chessen, George G Fischer, Irwin E Gaynon, Harvey C Gunderson, Richard B Hadley, Robert Hansen, Kenneth H Hinderer, John A Kirschner, Walter E Loch, Roland M Loring, Joseph Ogura, Charles J Puerillo, Ivan W Philpott, Ralph H Riggs Pinckney W Snelling Carl B Sputh, Jr , and Russell I Williams

Applicants must be diplomates of the American Board of Oto-Laryngology Class limited Apply to Dr Clifford G Grulee, Jr Director of Graduate Medicine School of Medicine, Tulane University, 1430 Tulane Avenue, New Orleans 12, Louisiana

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BRONCHOESOPHAGOLOGY COURSE

The next Bronchoesophagology Course to be given by the University of Illinois College of Medicine is scheduled for the period October 24 to November 5, 1955, under the direction of Dr Paul H. Holinger

Interested registrants will please write directly to the Department of Otolaryngology, University of Illinois College of Medicine, 1853 West Polk Street, Chicago 12 Illinois.

NATIONAL SOCIETY MEETINGS

Schedule of Meetings for 1956

Eastern Section, to be held at the Statler Hotel, Boston, Mass, January 13

Middle Section, to be held at the Netherlands Plaza, Cincinnati, Ohio, January 16

Western Section, to be held at the County Medical Society Bldg, San Francisco, Calif, January 21

Southern Section, to be held at the Shamrock, Houston, Texas, January 27-28

American Board of Otolaryngology, to be held at the Sheraton-Mt Royal, Montreal, Canada, May 6-11

American Otological Society, Inc, to be held at the Seigniory Club, Montreal, Canada, May 11-12

American Laryngological Association to be held at the Seigniory Club, Montreal, Canada, May 13-14

American Broncho-Esophagological Association, to be held at the Sheraton-Mt Royal, Montreal, Canada, May 15-16, (afternoons)

The American Laryngological, Rhinological and Otological Society, Inc., will hold its Annual Meeting at the Sheraton-Mt Royal, Montreal, Canada, May 15-16-17 (mornings only)

Please make early plans to attend the 1956 Spring Meetings in Canada Both the Seigniory Club and Montreal present most attractive features for you and your family More information about the places will be told to you

Reservations at the Sheraton-Mt Royal Hotel should be made early by addressing the Reservation Supervisor, 1455 Peel Street, Montreal, P Q, Canada

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SURGICAL PATHOLOGY OF CANCER OF THE LARYNX.*†

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St. Louis, Mo

INTRODUCTION

Since malignancies of the larynx are usually resectable surgical success is principally limited by metastatic disease and local recurrences Likelihood and location of local metastases, therefore should determine the extent of the surgical procedure. Recently, Italian[7, 78] and South American[25, 60] authors have attributed their improved surgical results to the employment of more radical procedures in relatively earlier stages of cancer of the larynx

They have demonstrated that metastases often occur earlier than had previously been appreciated Since their studies were not reported in detail, it seemed highly desirable to undertake a pathologic study of specimens removed following laryngectomy and radical neck dissection, in order to reach a better understanding of the problem confronting the surgeon

In the area of pathology of carcinoma of the larynx it is unfortunate that most previous discussions have been confined primarily to the larynx On occasion, some attention has been given to the thyroid cartilage, the pre-epiglottic

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* From the Department of Otolaryngology Washington University School of Medicine.

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space and the immediate structures about the larynx, but their invasion has not been related to metastases in the lateral cervical lymph nodes

Lymphatic spread into the deep cervical nodes has been thought to occur late, or rarely from intrinsic carcinoma of the larynx, and commonly only from the extrinsic variety Disagreements and variations in classification, in specific selection of only ideal cases for treatment and in methods of study used, have made it difficult to correlate and evaluate the facts and opinions about cancer of the larynx It is the opinion of the writer that the incidence and area of impalpable metastases from various local sites are frequent and wide, and that, from a surgical pathologic study of the local lesion, certain predictions may be made regarding the likelihood of metastases in the cervical lymphatics

REVIEW OF THE LITERATURE

During the past seventy-five years the literature on laryngeal carcinoma has been concerned mainly with diagnosis, surgery or radiotherapy, long term results and in only general terms with pathology Nearly all of the earlier articles,[16, 17, 22, 31, 40, 41, 66, 67, 102] and both early[11, 60, 61, 62] and recent[3, 8, 29, 42, 43, 51, 66] textbooks on otolaryngology have emphasized descriptions of the site of origin, have recognized that epidermoid carcinoma is the commonest malignant tumor, and have stressed differences in general pathologic behavior between intrinsic and extrinsic carcinoma of the larynx

Classification —Krishaber,[49] in 1879 first used the term "intrinsic" to include tumors on the laryngeal surface of the epiglottis and on the true and false cords St Clair Thomson[93, 94, 95, 96] further restricted the term to include only tumors occurring on the true and false cords and in the ventricle, while Walsh[99] used it to refer to tumors only on a freely movable true cord

Semon[86, 87] introduced the term endolaryngeal for all tumors within the larynx, and Walsh[99] restricted it for tumors on the true and false cords and in the ventricle The term subglottic was mentioned by Morell McKenzie,[62] in 1880, as "vocal cord and subglottic region", but it was not until 1930 that St Clair

Thomson recommended that the classification of subglottic cancer be differentiated from intrinsic, because of its different behavior

Both early[11,80] and recent[3,42,66] textbooks on otolaryngology have referred to a lesion located on the epiglottis, the aryteno-epiglottic fold, and in the pyriform sinus, as extrinsic carcinoma of the larynx. The term laryngo-pharyngeal cancer, for pyriform sinus carcinoma has been popular in Europe[14,39,46,78,81], and South America.[9,79,89]

Diagnosis—The first positive diagnosis by biopsy of the larynx and histo-pathologic examination was made by Morrell McKenzie[63] For years, many laryngologists[58,59,60] opposed biopy for fear of spreading the cancer and of making a benign growth malignant. Jackson[40,41] felt that biopsy and histologic examination were the only certain way for diagnosis By 1926 the necessity of biopsy became universally accepted

Grade—Broders[10] in 1920 emphasized the importance of grading The following statements epitomize the many assertions that have been made about the degree of differentiation[1,2,14,26,27,34,42,45,56,63] "An undifferentiated tumor responds better to irradiation than a well differentiated carcinoma" or a "well differentiated tumor is more amenable to surgery than an undifferentiated carcinoma"

It has been pointed out by Jackson[12,43] that apart from the peculiar lymphatic distribution of the true vocal cord, a Grade I or II biopsy material from the cordal region does not necessarily represent the state of the entire tumor Frequently the advancing margins are more undifferentiated, and anaplasia is often associated with lymphatic invasion. New and Fletcher[76] showed that the more undifferentiated the tumor, the further the tumor extended beyond the apparent normal margin At the present time the grading of tumors is significant only to the extent that it is related to other factors

Type—About 95 per cent of the carcinomas occurring in the larynx are epidermoid or squamous cell variety[1,2,17,21,39,42,47,61,81] (In Europe[15,39,56,64,78,81] and South America[9,64] these are referred to as epitheliomas, spino-cellular variety) The remainder are composed of the basal cell and alveolar variety

Location of Primary Lesion — Many authors[19, 27, 23, 33, 42, 46, 52, 58, 59, 64, 97, 98] have stated that the common site of origin of true cordal tumors was on the upper surface of the anterior two-thirds The order of frequency of the remaining primary sites was the base of the epiglottis, anterior commissure, arytenoid, ary-epiglottic fold and pyriform sinus[58, 59]

Local Limiting Structures—It has been stated that the cartilaginous structure of the larynx[43, 56] limits the spread of cancer into the lateral neck Breakthrough of cancer anteriorly through the thyroid cartilage has been mentioned by McKenty,[50], Le Roux-Robert,[56] Frazer,[32] Broyles[12] and Jackson[47] Broyles[12] emphasized that the anterior commissure tendon was the commonest route of the thyroid cartilage invasion by carcinoma Other cartilaginous structures may be invaded by malignancy

Destruction of the epiglottic cartilage by carcinoma and invasion of the pre-epiglottic space has been mentioned by Le Roux-Robert,[56] Caliceti,[15] Clerf[19] and Bisi[4] The importance of the limitation of cancer by the pre-epiglottic space has been emphasized by these authors Le Roux-Robert[56] pointed out the rarity of involvement of the cricoid and arytenoid, and Terracol[91] wrote of an instance where the arytenoid cartilage was infiltrated by cancer

Local and Other Spread—Le Roux-Robert[56] presented a lucid account of the various sites of origin of laryngeal cancer, and its mode of local spread He pointed out that subglottic tumors do not ordinarily invade the supraglottic area and vice versa

Subglottic tumor is an infiltrative neoplasm and it often displaces intact mucosa but seldom infiltrates the arytenoid cartilage Supraglottic tumors, *i e*, epiglottic carcinomas, not only invade the pre-epiglottic space, but also extend into the ary-epiglottic fold Strictly unilateral false cord and ventricular tumors, which are unusual, may become bilateral and extend superiorly, but usually extend minimally *inferior* to the cord

Snitman[illegible] demonstrated surface extension and infiltrative characteristics of cancer on the true cord, and he showed by serial sections how cancer on one true cord can grow on the surface to the anterior commissure, then down the opposite cord Hassin,[illegible] pointing out that the infiltrative nature of the carcinoma of the true cord caused degenerative changes in the muscle fibers, believed that this, rather than a nerve involvement, was the main cause for fixation of the vocal cord

Immediate direct extralaryngeal soft tissue involvement by cancer has been observed by other authors[60, 72, 73, 78] Involvement of such structures as the pretrachael and prelaryngeal muscles and thyroid are not infrequently noted

Lymphatics —Semon[66] attributed infrequent spread of cancer from the true cord to the poor lymphatic supply of the vocal cord Nodal metastases from carcinoma of the larynx have long been recognized to occur with high frequency in the extrinsic form and very infrequently or rarely with carcinoma, limited to the true cord

Extensive and detailed studies of the lymphatic supply of the larynx have been described by many authors[illegible] The supraglottic structures are drained by lymphatics which accompany the superior laryngeal vessels. The infraglottic structures are drained by lymphatics, which course anteriorly to the prelaryngeal node or laterally through the cricothyroid membrane to the paratracheal or deep cervical nodes The deep cervical nodes are eventually reached by drainage from above and below the true cords

It has been mentioned that differences in classification of intrinsic and other carcinomas within the larynx, lack of standardization of terminology and variation in methods of treatment have made it difficult to evaluate the frequency of cervical metastases. Taylor and Nathanson[80] have stated that metastases from "intrinsic" cancer are rare, but they do not mention subglottic cancer Only recently, other authors[20, 72, 73, 74, 76] have emphasized the likelihood of lymphatic metastases from subglottic cancer

The surgical results of early cancer restricted to the true cord (intrinsic) have been good[30, 42, 44, 52, 53, 54, 67, 93] with a [illegible] per cent recovery by the transoral or laryngo-fissure route. The incidence of metastasis from movable true cordal cancer has been low and reported variously from 4 to 15 per cent[2,44,76,8]

From the literature it has been difficult to determine the exact incidence of cervical metastasis from intrinsic cancer, since local recurrences and metastases have frequently been reported together The reported high cure of intrinsic cancer has been related to the low metastatic incidence from tumors on the true cord

The situation has been quite different with advanced laryngeal carcinoma The principal cause of *failure in more advanced* cancer treated by laryngectomy alone has been due to "local recurrences" and to cervical metastases,[2,18,20,21,43,44,52,63,65,71,85,98] As a result, radical neck dissection and laryngectomy at first in two stages and later in one stage, have been done[6,8,13,21,25,47,57,65,68,72,73,75,76,78,79,89,101] Many authors[7,9,21,28,72,73,74,76,78,79,89] have recently advocated elective or prophylactic neck dissection with laryngectomy on the basis that impalpable metastases were present in a high incidence The writer, however, has been unable to find any published reports on a series of consecutively operable cases of laryngeal carcinoma, with and without palpable nodes, that has been subjected to detailed pathologic analysis

OBJECTIVES

The objectives of the present study are

1 To classify and to study the characteristic features and mode of local spread of primary laryngeal carcinoma

2 To correlate site of primary lesion with incidence and location of palpable and impalpable metastases in the lateral cervical lymphatics

3 To study invasion of cancer in the thyroid cartilage and in the pre-epiglottic space with respect to the incidence of nodal metastases

4 To relate the incidence and association of cancer in prelaryngeal nodes with tumor in the lateral cervical lymphatics

5 To study infiltration of cancer in the immediate extralaryngeal soft tissue structures, the thyroid *gland*, the sternothyroid and sternohyoid muscles, and the prelaryngeal and paratracheal nodes

The data derived should lead to pertinent conclusions relating to surgery of laryngeal carcinoma.

METHOD OF STUDY

Selection of Specimens—The material obtained for study consisted of 59 specimens for *en bloc* laryngectomy and neck dissections in consecutive unselected patients with endolaryngeal, subglottic and extrinsic carcinoma of the larynx, from 1948 to 1954 The specimens obtained were divided according to whether neck dissection was therapeutic* or elective**

Unilateral therapeutic or elective neck dissection was done when the tumor was confined to one side, or had just crossed the midline Bilateral neck dissection was done only if the local lesion was extensive and bilateral, *i e*, in epiglottic carcinomas There was no selection of patients for irradiation therapy first, unless this therapy was given elsewhere and the tumor persisted, or surgery was contraindicated

It should be pointed out that 12 who had separate operations of laryngectomy and neck dissections were omitted Ten of these were the operations performed before the development of the one-stage operation The remaining two represented therapeutic neck dissection long after laryngectomy These two were observed during the same period as the 59 for which the one-stage operation was performed

One of the two should have had an elective neck dissection at the time of laryngectomy, but further surgery was deemed inadvisable because of the poor condition of the patient. In the other case, laryngectomy was thought to be sufficient because the paretic cord was adjudged to be movable that is, a cord without muscle invasion, but a year later secondary neck dissection became necessary

Early cancer restricted to movable true cords was excluded from this study *e g*, intrinsic cancers ideal for transoral or laryngo-fissure, and bilateral cordal carcinomas treated by wide field laryngectomy alone

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*Therapeutic neck dissection refers to surgery for clinically positive nodes.

**Elective neck dissection refers to surgery in the absence of palpable nodes.

The present contraindications for surgery constituted another group excluded from this study They are 1 Fixed, matted cervical mestastases 2 Anaplastic carcinoma (Grade IV by biopsy) with palpable adenopathy low in the neck 3 Bilateral large cervical metastases, despite mobility 4 Demonstrable distant or pulmonary metastases 5 Extremely poor surgical risks 6 Refusal of surgery

Examination of Material —The larynx was immediately split posteriorly in the midline of the cricoid cartilage and into the inter-arytenoid area, and then it was held apart and photographed The larynx and lymph nodes were studied in the following manner

Larynx —The exact shape, extent, size and surface characteristics of the tumor in the larynx were drawn to full scale from the superior or mirror view, posterior view with cricoid cartilage split, sagittal view, and frontal view

The local lesion was examined grossly and microscopically for the following features Ulceration and infiltration, fungation and infiltration, exophytic or papillary structure, mucosal and submucosal displacement, type and final grade of the tumor, lymphatic, perineural lymphatic and vascular invasion

Sagittal section, which included the hyoid bone, the first tracheal ring and the intervening structures was made Tissues were uniformly taken for sectioning for microscopic examination Multiple vertical stepwise sections of the pre-epiglottic space and the anterior thyroid and cricoid cartilages were made Transverse or vertical sections of the arytenoid eminences, including the pyriform sinus were taken

Several sections in various planes of lesions of the true and false cords and subglottic areas were taken The superior, lateral, inferior and medial margins of tumors of the epiglottis, aryteno-epiglottic fold and pyriform sinus were also taken Sections were prepared of the thyroid gland and the sternohyoid and sternothyroid muscles

The conventional method for decalcifying cartilage and bone with formic acid was used, and sections were stained with hemotoxylin and eosin

Lymph Nodes —After the nodes were removed and studied they were plotted on a full scale drawing of the neck and grouped according to their location as follows

1 Anterior triangle
    a. Submental
    b Submaxillary or digastric (between mandible and anterior and posterior belly of digastric muscle)
        1—Superior internal jugular (most superior node along the internal jugular vein)
        2—Jugular-digastric.
    c Superior triangle (between sternomastoid, omohyoid and digastric muscles
        1—Middle internal jugular (between digastric and omohyoid muscle)
        2—Parotid.
    d Inferior triangle (between sternocleidomastoid and omohyoid muscles and the midline)
        1—Prelaryngeal
        2—Paratracheal (posterior and medial to the thyroid gland)
        3—Jugular omohyoid
        4—Inferior internal jugular (lowest node along internal jugular vein)
2 Posterior triangle (between sternocleidomastoid muscle, clavicle and trapezius muscle)

All nodes were fixed in 10 per cent formalin as one of the above groups for 24 hours, split in their long axes, and examined for tumor characteristics Occasionally, the tumor was obvious or suspicious in the peripheral sinusoids of the impalpable nodes

Saphir[92] has shown that serial sections of axillary nodes previously reported negative will often reveal carcinoma Initially, it was our practice to make many sections at various depths on a tissue block for each node, however, it was not possible to carry out serial sections of every node in a project of this size An approximation was achieved by making two sections one was superficial, and another was deep of several previously multidivided nodes mounted on a single tissue block When the characteristic gross features of the node revealed tumor, only a single section was made

CLASSIFICATION

Primary Lesion —The clinical criteria for the classification of laryngeal carcinoma suggested by Walsh[99] were employed in this study Clinical observations of the larynx may not always correlate with what is seen at operation, or on histologic section It is well known that tumors visualized indirectly, or even by direct laryngoscopic methods, are often found to be much more extensive after surgical excision than expected Thus, a few carcinomas thought to be of endolaryngeal origin prior to surgery are actually found to be the subglottic or extrinsic type, therefore, final classification of the specimens was based upon the findings of pathologic examination

Endolaryngeal —Endolaryngeal lesions are limited to the true and false cords and ventricle (see Fig 1) The free border of the true vocal cord represents the inferior boundary, and an arbitrary line along the most superior border of both false cords constitutes the upper limit A small area of the extreme base of the epiglottis is included where there is an area of union of the false cords and the posterior limit is the body of the arytenoid cartilage

The vocal process will fall within the endolaryngeal area When subglottic extension of only a few mm beneath the true vocal cord occurs the classification has been endolaryngeal Actually, our present term *endolaryngeal* refers to the old St Clair Thomson terminology for *intrinsic cancers* In the present classification the term *intrinsic* refers only to cancer restricted to the mobile true cords

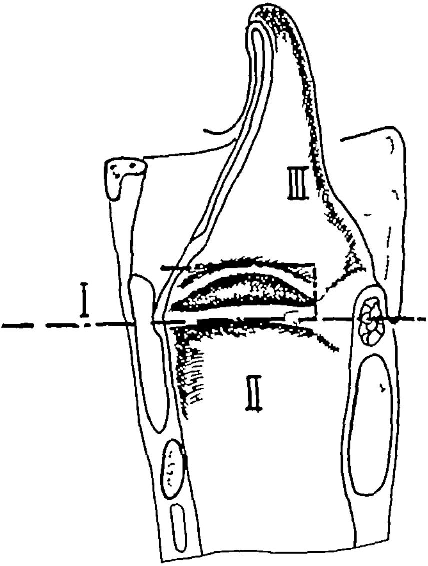

Fig 1 Classification of carcinoma of the larynx. I—Endolaryngeal II—Subglottic. III—Extrinsic.

Extension of the tumor by the mucosal or submucosal routes into the aryepiglottic fold or further into the base of the epiglottis, into the pyriform sinus or the arytenoid eminence places the lesion in the extrinsic classification In two instances in the writer's series the lesion was extensive, involving the base of the epiglottis the cords and the subglottic areas In such areas the center of the lesion was taken to be the primary site In one of two instances, the tumor was classed as epiglottic, and in the other definitely as subglottic

Le Roux Robert[56] used the term "vestibular carcinoma to include tumor on the base of the epiglottis and the false cord, i e, the inferior half of the epiglottis Pietrantoni, et al[78] used the same term to include the entire base of the epiglottis and the arytenoid area as well (see Fig 2) To avoid con-

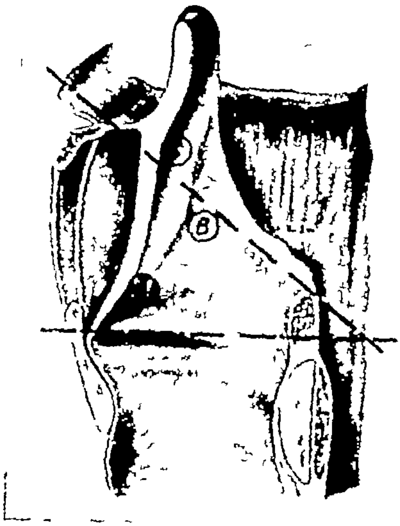

Fig 2 Vestibular Carcinoma (from Pietrantoni et al) A—Inferior vestibular carcinoma B—Superior vestibular carcinoma C—Epiglottic carcinoma

fusion this term was not used here, since malignancies of this region would overlap what this study refers to as the extrinsic area

Subglottic—Subglottic lesions are confined beneath the true cords (see Fig 1) The superior margin of the tumor may extend to the free border of the cord and displace the floor of the ventricle superiorly Carcinoma of the true vocal cord that extends for a millimeter or two beneath the cord is not a true subglottic lesion The inferior border of the cricoid cartilage constitutes the lower boundary of the subglottic area, and a primary lesion below the cricoid is considered to be tracheal in origin

Extrinsic—Extrinsic lesions involve the base of the epiglottis, aryepiglottic fold, pyriform sinus, or the arytenoid eminence (see Fig 1) Post-cricoid carcinoma is not included in this study, as this lesion represents an esophageal carcinoma

Cervical Nodes Definition of Clinically Palpable and Clinically Negative Nodes—Pre-operatively, nodes in the neck are either impalpable or clinically palpable, i e, clinically positive Histologically, firm palpable nodes almost always show cancer Small nodes that contain carcinoma are often "just palpable" or "questionably palpable" In most instances, the diagnosis was confirmed and justified the clinically positive classification, and will be referred to in the tables as *palpable-positive*

Impalpable lymph nodes, or nodes that are "questionably" or "barely palpable" and are microscopically negative, were grouped as clinically negative and microscopically negative *(impalpable negative)* Clinically impalpable nodes that were microscopically positive *(impalpable positive)*, are instances where there was not even a suggestion of a node to palpation, and the true nature was revealed only by a systematic pathologic examination Except for the prelaryngeal and para tracheal nodes, for purposes of tabulation in the illustrations, the demonstration of two or more microscopically positive nodes in one or both sides of the neck dissection specimen was listed only once

RESULTS

Laryngeal Lesion *Endolaryngeal Carcinoma*.—There were 18 endolaryngeal carcinomas in this group, with eight on a fixed true cord, seven on both the true and false cords, two on the false cords, and one in the ventricle A typical example of endolaryngeal carcinoma is illustrated in Fig 8

The site of origin of carcinoma of the true cord was usually found on the free or upper surface of its anterior one-third While carcinoma remained localized to this portion for some time it extended anteriorly to the anterior commissure, superiorly and anteriorly to the false cord junction and into the ventricle and posteriorly to the vocal process (see Fig 4)

Further mucosal spread at the anterior commissure onto the surface of the opposite cord for 1 to 2 mm and into the subglottic area frequently occurred In two instances the tumor arose from the anterior commissure, but predominated more on one side or the other by the nature of its advancing border, or its type of attachment.

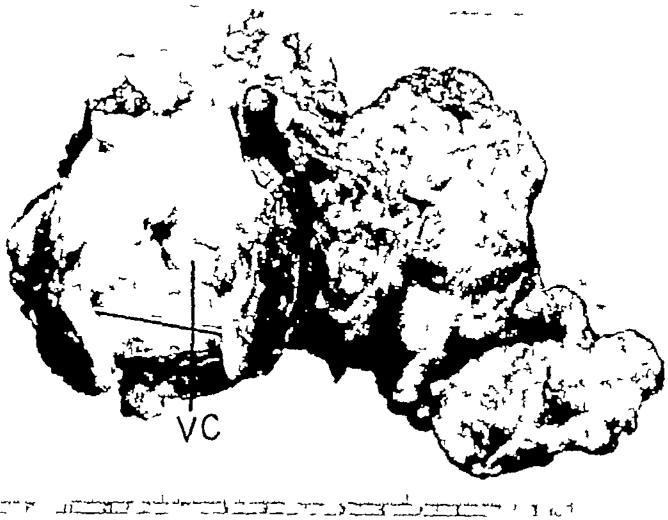

Fig 3 A typical specimen of endolaryngeal carcinoma The true cord was fixed and the cervical nodes were negative VC—True vocal cord (This patient is alive and free of disease three years after surgery)

Fixation of the true vocal cord was due to deep invasion of the intrinsic muscles by tumor, rather than to invasion of

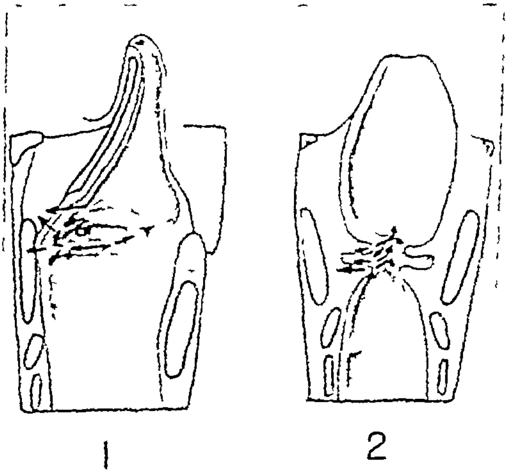

Fig 4 Local spread and extension in endolaryngeal carcinoma 1 Sagittal section—Three arrows indicate the route of possible extension into the thyroid cartilage and the pre-epiglottic space 2 Frontal section anterior view

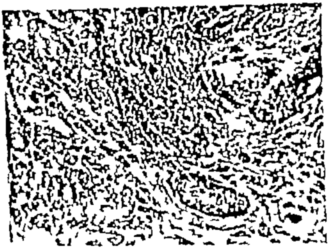

Fig 5 Note the zone of degenerating muscle fibers A, located between normal muscle and tumor

the arytenoid cartilage There was loss of striations, fragmentation and degeneration, lysis of the muscle fibers and a varying degree of round cell infiltration (see Fig 5) Frequently, lymphatic invasion was noted in the intrinsic muscle area (see Fig 6)

Tumor often was found spreading submucosally to the lateral border of the ventricle adjacent to the thyroid cartilage, and in its posterior extension along the vocal cord was often observed about the vocal process (see Fig 7)

In two of eight instances there was erosion and destruction of the anterior thyroid cartilage The pre-epiglottic space was not invaded in any instance

In all seven cancers of the true and false cords, the lesion was predominantly unilateral The area of invasion was the

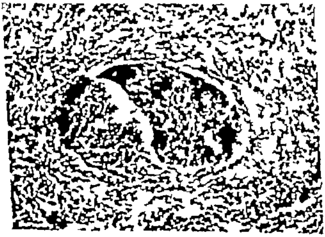

Fig. 6 Tumor with a vascular channel of the intrinsic muscles.

crossed the anterior midline by 1 to 2 mm at the most The remainder of the group were strictly unilateral (see Figs. 8, 9)

Except for one instance which was exophytic, the remainder were ulcero-fungating in the center of the lesion, and the advancing margins invaded the intrinsic muscles of the true cord, and frequently displaced intact mucosa near the free border of these cords This produced the effect of a thickening of the true cord, and its fixation was due to invasion of its intrinsic muscles

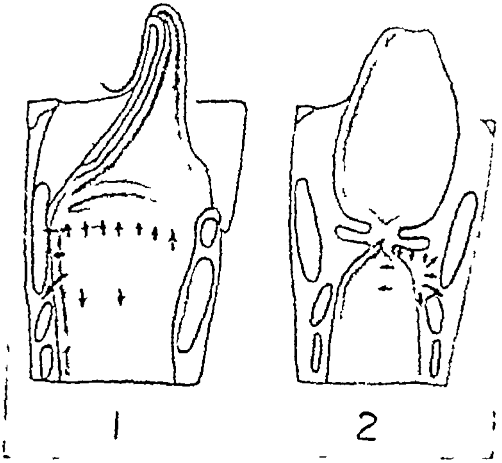

Fig 9 Local spread and extension in subglottic carcinoma 1 Sagittal section 2 Frontal section anterior view (Note arrow that extends into the cricothyroid membrane)

The unilateral lesions had a center of origin 0 6 to 1 0 cm midlaterally beneath the true cord The bilateral lesion likewise occurred 0 7 to 1 0 cm beneath the cords, but its center of origin was more anterior in position with respect to the lateral subglottic area

Subglottic cancer quickly invades to the perichondrium of the thyroid and cricoid cartilages and always extended to and frequently through the cricothyroid membrane (three of 13) It may impinge upon or displace the cricothyroid membrane, and may infiltrate through it anteriorly or antero-laterally into the soft tissues of the neck (see Fig 10)

In only one instance, the cricoid cartilage was partially invaded at its midsuperior border Extension posteriorly across the midline seldom occurred, but on reaching the inferior arytenoid area tended to involve the perichondrium of the cartilage. There was absence of destruction of the arytenoid carti

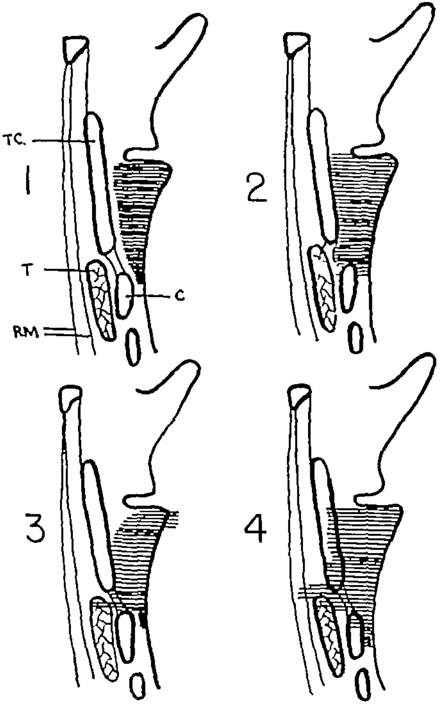

Fig. 10 Extension of tumor in subglottic carcinoma sagittal views. 1. Tumor adjacent to perichondrium of the thyroid cartilage. 2. The cricothyroid membrane is displaced forward by tumor 3 The isthmus of the thyroid is infiltrated by tumor (A section lateral to this area may show invasion of the lateral lobe.) 4 Invasion of the thyroid and ribbon muscles. TC—Thyroid cartilage C—Cricoid cartilage T—Thyroid gland. RM—Sternothyroid and sternohyoid muscles

lage In one instance, the tumor extended above the arytenoid cartilage by "circling" around it

Supraglottic invasion, mentioned above in the classification, was observed once Erosion of the anterior thyroid cartilage by tumor was found once, invasion of the ribbon muscles opposite the anterior crico-thyroid membrane twice, and involvement of the thyroid gland twice The infiltration of the pre-epiglottic space by tumor of subglottic origin was never demonstrated

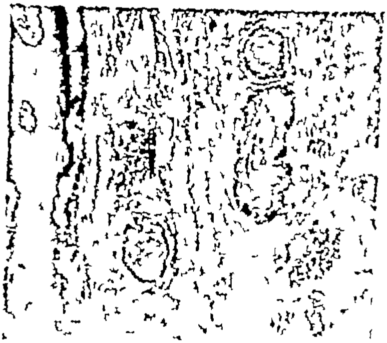

Fig 11 Cancer within the lymphatic channels in the subglottic tissue adjacent to the cricoid cartilage

Twenty-nine out of the 31 endolaryngeal and subglottic tumors were of squamous cell variety (93 6 per cent), and the remaining two were of the alveolar type There was one adenocarcinoma in each group Of the squamous cell type, the tumor was of intermediate grade, either II or III Lymphatic invasion was frequently observed in the deep subglottic tissue (see Fig 11)

Extrinsic Carcinoma—Twenty-eight lesions were in the extrinsic group, with 16 in the pyriform sinus, eight on the aryepiglottic fold and four on the epiglottis

Pyriform Sinus—Pyriform sinus malignancies can be divided as arising primarily from its lateral wall, apex, or medial wall (lateral arytenoid eminence)

It was of little practical value to separate the tumors into these groups, since all three areas were involved to varying degrees A lesion primary in the lateral wall of the pyriform sinus always involved the medial wall (lateral arytenoid eminence) to a certain degree, likewise the reverse was also true With involvement of the medial wall the cord was frequently fixed.

Characteristically, these tumors were of the ulcero-fungating type and invaded in the following manner (see Figs 12, 18) When the neoplasm was primary on the lateral arytenoid eminence, infiltration submucosally into the aryepiglottic fold soon caused marked broadening of the structure and distortion of the epiglottis

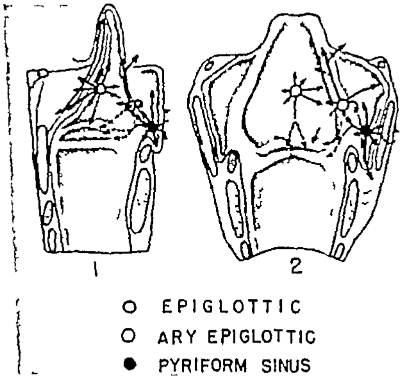

FIG 12. Local spread and extension in extrinsic carcinoma. 1 Sagittal view 2 Posterior view with the cricoid cartilage divided in the midline (The dotted arrows indicate spread by the submucosal route The dotted arrow in the pyriform sinus shows extension around the posterior border of the thyroid lamina.)

Further extension beyond the aryepiglottic fold into the glosso-epiglottic fold resulted with invasion into the base of the tongue The thyroid cartilage and thyrohyoid membrane cannot efficiently restrict lateral extension, and superior extension into the laryngopharynx and on the posterior wall of the pyriform sinus always occurred.

When tumor spread posteriorly to the arytenoid, it readily crossed the midline in the superior post-cricoid area when it extended inferiorly to the arytenoid, there was infiltration of the wall of the upper esophagus A portion of the apex of the pyriform sinus located between the firm structures of the thyroid and cricoid cartilage, will resist invasion, but the tumor can readily spread laterally around the posterior border of the thyroid ala to its external perichondrial surface

Direct lateral extension of the tumor will not only place the cancer in immediate relation to the great vessels of the neck, but on occasions it will also invade the capsule of the superior lobe of the thyroid gland (twice) Surprisingly, the lateral wing of the thyroid cartilage was invaded only once, and posterior invasion of the prevertebral fascia was not found

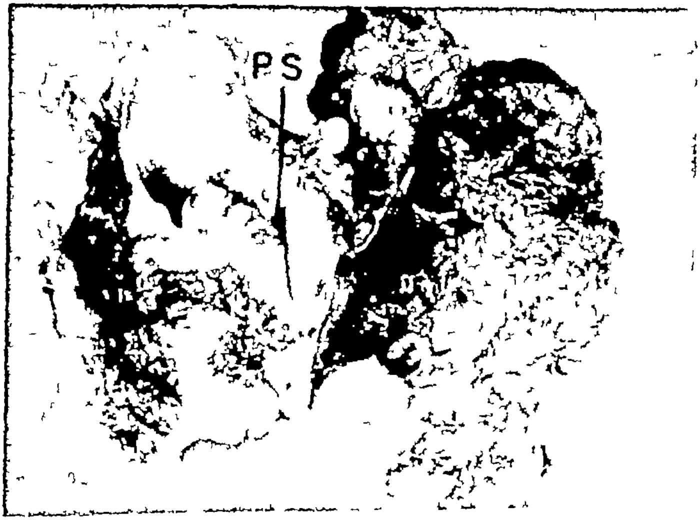

Fig 13 A typical specimen of a pyriform sinus carcinoma Note the deep ulcer in the apex of the pyriform sinus This specimen was removed from a patient who was treated with irradiation and followed by surgery The cervical nodes were negative PS—Pyriform sinus (The patient is alive and free of disease six years later)

The endolaryngeal structures, such as the ventricle false cords and true cords are often secondarily invaded by the submucous "retrograde" route, but subglottic invasion was not demonstrated The anterior thyroid, cricoid cartilages and the hyoid bone were not invaded in any instance When the aryepiglottic fold was secondarily infiltrated, the lateral pre-epiglottic space was occasionally invaded Cancer often approached the arytenoid cartilages, but actual invasion occurred only once

All of the tumors of the pyriform sinus were of the epidermoid variety, and Grade III predominated in this group Perineural lymphatic and submucosal lymphatic invasion was frequently noted (see Fig 14)

Aryepiglottic Carcinoma.—In five of eight, the free border of the aryepiglottic fold in the region of the cuneiform tubercle was the primary site of origin (see Fig 12) Three of eight tumors had their center of origin closer to the aryepiglottic fold than the midbase of the epiglottis These were classified as aryepiglottic in origin rather than epiglottic even though the edge of the tumor extended to the midline. All showed the surface characteristics of ulceration and fungation (see Fig 15), except one which was of the exophytic type.

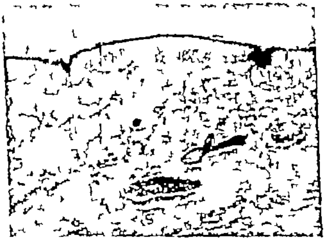

Fig 14 Note the numerous lymphatic channels in the submucosa and tumor within two of the vessels.

Infiltration submucosally took place towards the arytenoid eminence on the laryngeal surface of the epiglottis and into the medial wall of the pyriform sinus In seven of eight the tumor manifested itself on one side of the epiglottic cartilage and in the lateral pre-epiglottic space Usually the aryepiglottic fold was broadened and the epiglottis distorted

With advance of the cancer progression into the glosso-epiglottic fold and the tongue resulted (see Fig 16) Fre-

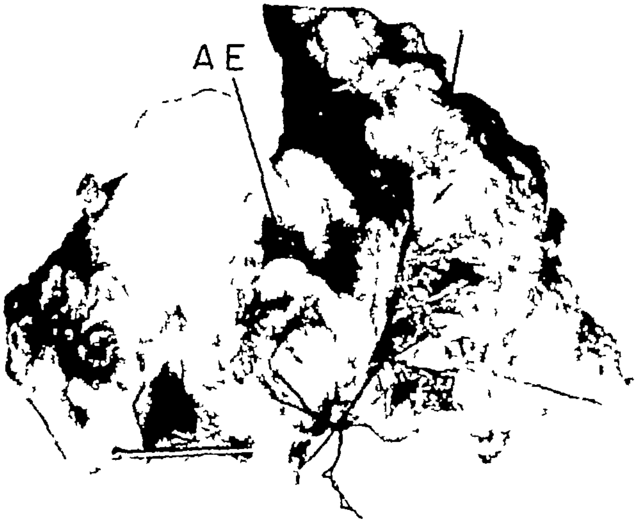

Fig 15 A typical specimen of aryepiglottic fold carcinoma Note the ulceration and infiltration extending into the pyriform sinus The arrow points to a palpable cervical metastasis AE—Aryepiglottic fold (Subsequently the patient developed bronchogenic carcinoma and lived two years)

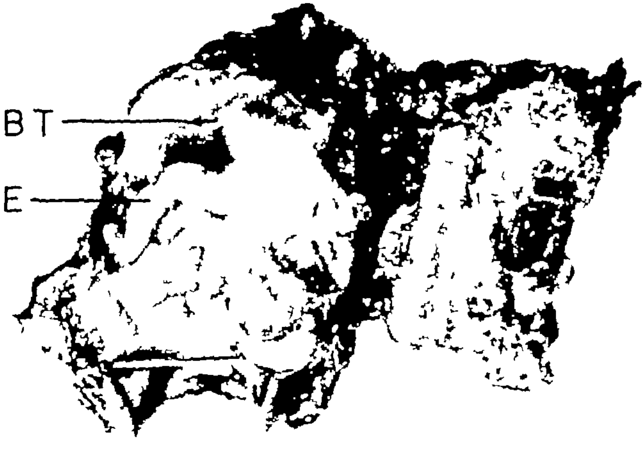

Fig 16 A typical specimen of aryepiglottic fold carcinoma Note the swelling of the aryepiglottic fold with distortion of the epiglottis and extension into the base of the tongue There were no positive nodes in the specimen *E—Epiglottis* *BT—Base of the tongue* (The patient is alive and free of disease two and one half years later)

quently, submucosal invasion of the endolaryngeal structures (ventricle, false cord and true cords) occurred, but subglottic invasion was not demonstrated

Seven of eight aryepiglottic fold cancers were of the epidermoid variety, and Grade II or III, while one was an adenocarcinoma The arytenoid cartilage was often surrounded by the tumor close to the perichondrium, but cartilage was invaded only once (see Fig 17) The hyoid bone, thyroid and cricoid cartilages were not involved

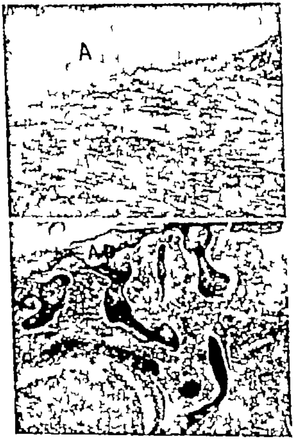

Fig 17 The upper photomicrograph taken at low power shows carcinoma immediately adjacent to the perichondrium of the arytenoid cartilage but there is no invasion of the cartilage A—Arytenoid cartilage

The lower illustration is a high power view and shows cancer infiltrating and destroying the cartilage. AD—Destruction of arytenoid cartilage

Epiglottic Carcinoma.—All four of the epiglottic carcinomas involved its base most of the laryngeal surface of the epiglottis and to some degree its mobile portion (see Figs 12, 18) Generally the tumor was midline in origin with predominant extension laterally either to right or to left into the aryepiglot

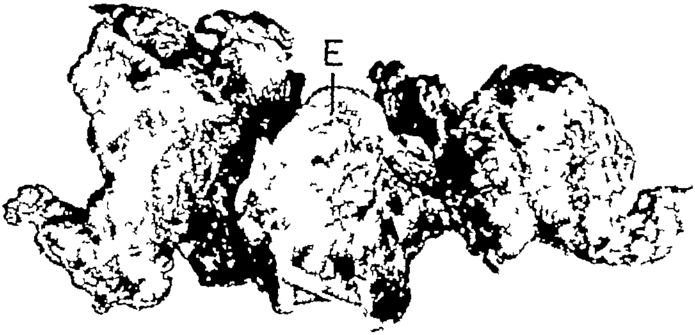

Fig 18 A typical specimen of epiglottic carcinoma E—Epiglottis The faint dotted line delineates the margin of the tumor There was one palpable node in the right lateral cervical area and one impalpable metastasis in the left cervical area. (The patient is alive and free of disease three and one-half years later)

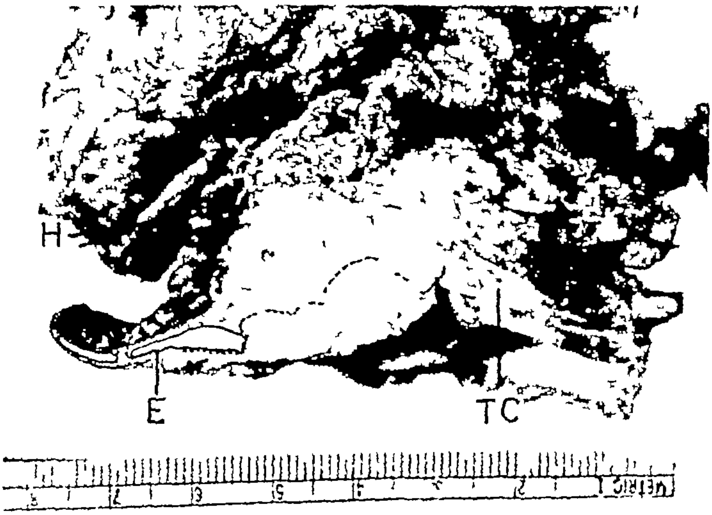

Fig 19 Invasion of the pre epiglottic space Sagittal view of specimen illustrated in Fig 18 The dotted line delineates the margin of the tumor in the pre-epiglottic space Note the destruction of the epiglottic cartilage TC—True vocal cord. H—Hyoid bone E—Epiglottis

tic fold Both false cords were invaded, particularly their anterior portions, and to some degree, the ventricle

All four tumors were of the ulcero-fungating type and invaded extensively the pre-epiglottic space anteriorly, superiorly and laterally (see Fig 19) They may even displace the epiglottis posteriorly The fenestrations of the epiglottic cartilage which normally contain mucous glands, permit the tumor to extend into the pre-epiglottic space, and the cartilage itself is frequently destroyed (see Fig 20)

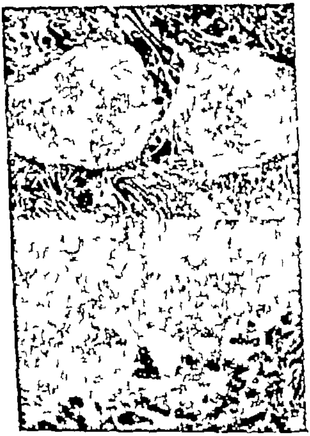

Fig 20 The upper illustration shows cancer infiltrating into one of the fenestrations of the epiglottic cartilage. Tumor is on both sides of the cartilage The lower figure shows cartilage destroyed by cancer

The neoplasm appeared to be restricted within the defined boundary of the pre-epiglottic space, but in extensive lesions the external surface of the anterior superior margin of the thyroid cartilage was invaded once and in two out of four instances, cancer infiltrated into the sternohyoid and sternothyroid muscles.

All four carcinomas of the epiglottis were of the squamous cell type and either Grade II or III Subglottic invasion was present in one of the four specimens. The hyoid bone, cricoid and arytenoid cartilage were not involved.

The general characteristics of extrinsic carcinoma revealed that 27 of 28 were of the ulcerating, fungating, and infiltrating type, and only one was of the exophytic type with minimal infiltrative tendency. Twenty-seven of 29 (96.4 per cent) were of the epidermoid type, and two were of the alveolar variety. There was a greater tendency for final Grade III in carcinoma of the extrinsic group than in the endolaryngeal group.

Other lesions of interest found in this series were one separate carcinoma *in situ* and two instances of hyperkeratosis of the true cord, one primary carcinoma of the lung and one of the pancreas, all found in association with extrinsic carcinoma of the larynx. Primary carcinomas of the esophagus and lung were found once, each associated with endolaryngeal and subglottic carcinomas, respectively.

TABLE I
INCIDENCE OF CERVICAL METASTASES RELATED TO PRIMARY LESION

Primary Lesion	Clinical and Histological Description of Cervical Nodes			
	Impalpable-Negative*	Impalpable-Positive*	Palpable Positive*	No of Specimens
ENDOLARYNGEAL				
Fixed True Cord	6	2	1	9
Fixed True Cord False Cord	2	2	2	6
False Cord	1		1	2
Ventricle			1	1
Totals	9	4	5	18
SUBGLOTTIC	6	6**	1	13
EXTRINSIC				
Pyriform Sinus	1	4	11	16
Aryepiglottic Fold	3	2	3	8
Epiglottis	2***	2***		4
Totals	6	8	14	28

* Negative and Positive denote demonstration or failure to demonstrate nodal metastases. See explanation under Classification Definition of Clinically Palpable and Clinically Negative Nodes.

** Includes one bilateral neck dissection.

*** Includes three bilateral neck dissections.

Cervical Node Mestastases Nodal Metastases from Endolaryngeal Carcinoma—An average of 34 lymph nodes were removed, with a range of 20 to 42, from each of the specimens of unilateral neck dissections for endolaryngeal carcinoma Of the 18 carcinomas, there were five associated with clinically *palpable* nodes, all homolateral to the primary lesion (see Fig 21)

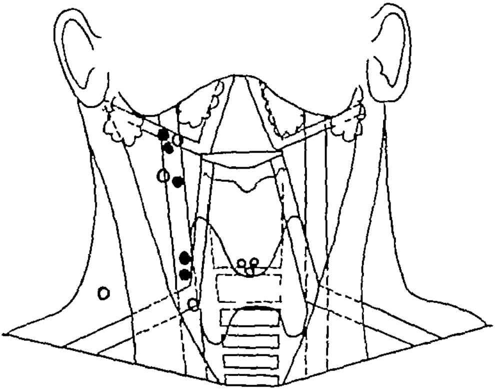

Fig 21. Distribution of palpable and impalpable metastases in 18 endolaryngeal cancers. ●—Palpable metastasis O—Impalpable metastasis Each circle represents the location of the involved node Negative findings are not in the illustration

There was a scattering of nodes palpable in the deep jugular chain without any tendency to localize to one area. Two were palpated at the jugulodigastric area, one opposite the pyriform sinus, one by the inferior cornu of the thyroid and one by the cricoid cartilage Each palpable node averaged 2 to 3 cm. in size and in four of the five specimens, two or more impalpable nodes were also demonstrated immediately adjacent to the main palpable mass In one of the four a small node was found high in the submaxillary triangle, superior to the main palpable node

In two instances, a microscopically positive paratracheal node adjacent to the medial and posterior surface of the thy roid gland was demonstrated. The submental nodes were negative.

In four of 13, an *impalpable* metastasis was found in a solitary lateral cervical node (31 per cent). Fig 21 shows the location of the metastases at the jugular-digastric, pyriform sinus, jugular-omohyoid, and the posterior triangle areas. In addition, in three instances the prelaryngeal node was microscopically positive. The four impalpable nodes averaged 0.7 cm in length with a variation in size from 0.5-1.3 cm (see Fig 22).

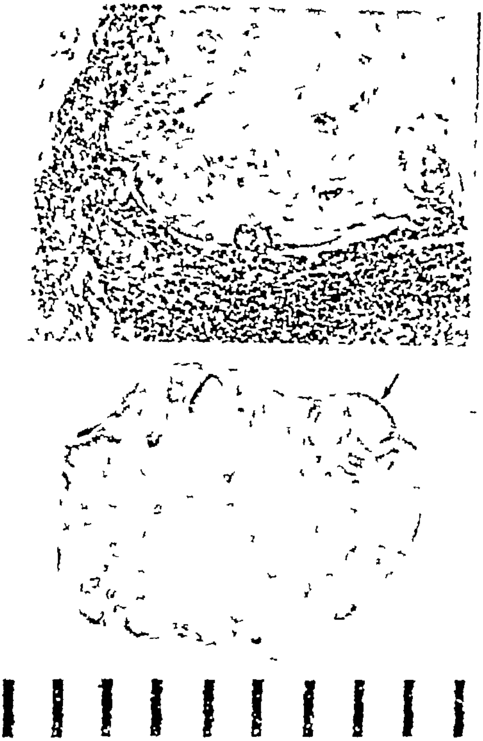

Fig 22 The lower photomicrograph shows a small focus of metastatic carcinoma in the periphery of a deep cervical node measuring 0.7 cm. Each line at the bottom represents 0.1 cm. The upper illustration is a high power view of the area of the arrow.

The three instances in which microscopically positive prelaryngeal nodes were demonstrated (average size 0.5 cm) were found to have positive nodes in the neck, twice as microscopic metastases in a solitary deep lateral cervical node and once as a small palpable cervical node

Nodal Metastases from Subglottic Carcinoma.—An average of 35 lymph nodes were examined, with a range of 25 to 42, in each of the specimens examined from 13 neck dissections for subglottic carcinoma. A clinically palpable node was present in only one patient, and this was demonstrated in the posterior triangle

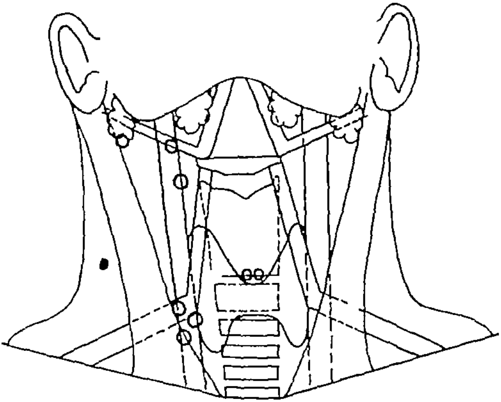

Fig 3 Distribution of palpable and impalpable metastases in 13 subglottic cancers. ●—Palpable metastasis. ○—Impalpable metastasis Each circle represents the location of the involved node Negative findings are not in the illustration.

In six of 12, *impalpable* metastases were demonstrated in lateral cervical nodes (50 per cent) Half of the impalpable metastases were located in the lower neck (see Fig 23) three of six in the jugular omohyoid area, one at the jugulo-digastric crossing one opposite the pyriform sinus and one in the parotid area.

One positive impalpable node was found on the major side of the lone bilateral neck dissection specimen (local lesion crossed minor side by 10 mm) Two impalpable metastases involved the prelaryngeal node, one of which was associated with simultaneous microscopic metastases in the neck, and the other was associated with a small palpable node in the posterior triangle

The average size of the two prelaryngeal nodes was 0 4 to 0 5 cm, while those in the deep neck measured an average of 0 8 cm with a variation from 0 5 to 1 5 cm (see Fig 24)

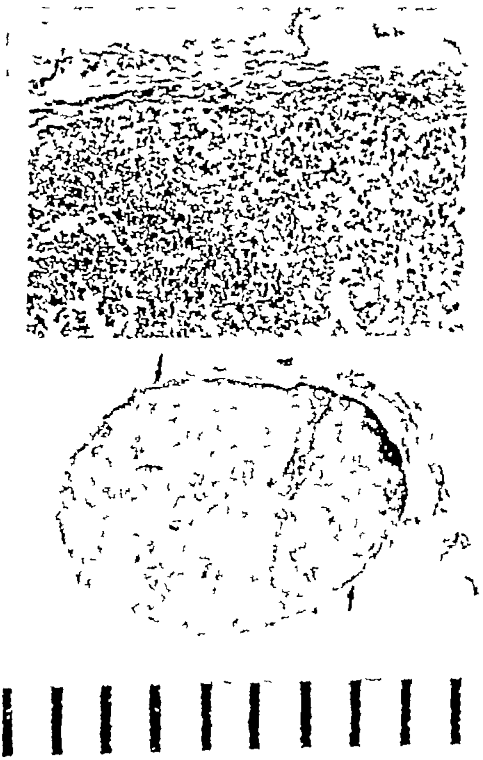

Fig 24 The lower photomicrograph shows two foci of carcinoma in the sinusoids of a deep cervical node measuring 0 7 cm Each line at the bottom represents 0 1 cm The top illustration is a high power view

In the group of six specimens without palpable nodes, two were found to have two coincident microscopically positive nodes in the deep jugular area Carcinoma was not demonstrated in the submental nodes

Nodal Metastases from Extrinsic Carcinoma —An average of 38 lymph nodes was examined, with a variation of 20 to 58 nodes, in each of the specimens of unilateral neck dissection for extrinsic carcinoma Up to 80 nodes were often found in the bilateral neck dissections Three bilateral neck dissections were done, all on epiglottic carcinomas Nodal metastases obtained from bilateral neck dissections were listed only *once* in the table, even if metastases were on both sides

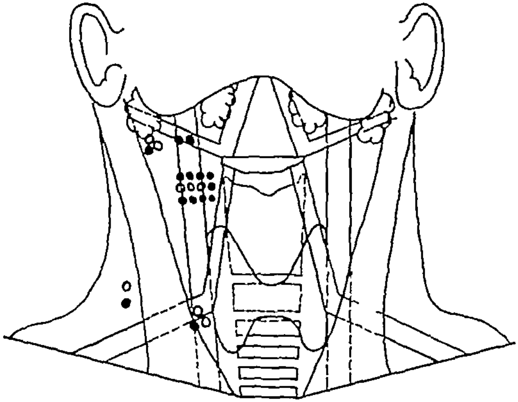

Fig 25 Distribution of palpable and impalpable metastases in 28 extrinsic carcinomas. ●—Palpable *metastasis*. O—Impalpable metastasis. Each circle represents the location of the involved node. Negative findings are not in the illustration.

The first epiglottic carcinoma presented a small palpable node on one side and none on the other One impalpable metastasis was demonstrated on the minor side This was listed under clinically "negative" and microscopically "positive" in order to direct attention to the incidence of impalpable nodes. The remaining two were bilateral elective neck dissections One of these showed carcinoma in impalpable nodes in both sides of the neck, and the other no metastases

In 14 out of 28 clinically *palpable* nodes were present at the time of operation (see Fig 25) The nodes varied in size.

The average was 3 cm in the long axis and was larger than those found in the endolaryngeal carcinoma In 13 of 14, while the main palpable node appeared to be movable and solitary, multiple nodal involvement immediately adjacent to the main mass was present

A maximum of 11 positive nodes was found in the one side of the neck In nine of 14, the commonest node involved was immediately adjacent to the pyriform sinus Every triangle of the neck was involved except the submental area Metastasis in a small high submaxillary node was found once as a small metastases in association with a larger one at the pyriform sinus area

In eight of 14 extrinsic cancers (57 per cent), *impalpable* metastases were demonstrated in the lateral cervical lymphatics These nodes averaged less than 1 0 cm in length and were demonstrated just below the jugulo-digastric area in three of eight instances, in the parotid area twice, in the posterior triangle once, and in the jugular-omohyoid area twice Multiple involvement of microscopically positive nodes was present in two cases The prelaryngeal node was negative in every instance

The great vessels in the neck are frequently invaded in extrinsic carcinoma of the larynx The internal jugular vein and the carotid artery were each invaded with cancer twice, and in both instances the tumor thrombus was present in the vein

Roentgen Therapy and Surgical Pathologic Observations — Observations were made on eight irradiated specimens removed subsequent to heavy Roentgen therapy In all instances, the decision for Roentgen therapy was made by another physician, and was referred for further treatment because of persistence of the primary lesion

Pertinent information was obtained from the otolaryngologist and radiologist concerning the cervical nodes, the size of the field and amount of irradiation given was obtained from the roentgenologist. The cutaneous response noted after therapy was correlated with the size of the field of irradiation

In one instance after treatment, a palpable node developed at the lower border of the field of irradiation and was confirmed in the specimen In two other instances, impalpable metastases were found one well outside of the field and one well within the field In the latter, it was not possible to determine whether this node developed before, during or after Roentgen therapy In three instances of positive nodes treated with X ray, cancer was still present in the nodes

In addition to the observations on the cervical nodes, there was noted in the primary lesion the usual irradiation response of fibrosis, thickening of vessels, varying degrees of focal necrosis and bizarre variations of the tumor cells The changes seen in the cartilaginous structures of the larynx were insignificant, and necrosis of cartilages was absent

CORRELATION OF NODAL OBSERVATIONS WITH THE LARYNGEAL LESION

Location of Laryngeal Lesion and the Lateral Deep Cervical Nodes—The *size* of the local laryngeal lesion was not related to the incidence, or to the appearance of the first evident metastasis Given the same local characteristics of ulceration, fungation degree of infiltration, and grade, a smaller lesion in an extrinsic area or subglottic area was as apt to metastasize as a larger one might not. The size and appearance of the laryngeal lesion with impalpable metastases, or clinically palpable nodes, was similar to lesions with negatives nodes

The *grade* of the entire local lesion was of little help in predicting cervical metastases There were just as many Grade III with or without microscopic or gross metastases as there were Grade II

The primary tumor whose gross characteristics were ulceration and fungation was usually associated with deep infiltration Those of the exophytic or papillary type only occasionally infiltrated the deeper tissue. There were 55 ulcerating fungating and infiltrating types, but only four exophytic types The incidence of cervical metastases was high in the former (37 of 55) while one of four exophytic types revealed a nodal metastasis Frequently, examination of the deeper tissues of the larynx in those instances with nodal metastases revealed perineural, lymphatic or vascular invasion by cancer.

The location of the primary lesion in the larynx was the most important factor in relation to the incidence and the area of cervical metastases. *Impalpable* metastases were demonstrated in the neck in eight of 14 extrinsic (57 per cent), in six of 12 subglottic (50 per cent), and in four of 13 endolaryngeal carcinomas (31 per cent). Ten out of 25 endolaryngeal and subglottic carcinomas revealed microscopic metastases in impalpable nodes (40 per cent). These nodal metastases were distributed widely, both in the upper and lower neck and were homolateral to the primary lesion.

TABLE II

INVASION OF THYROID CARTILAGE AND PRE-EPIGLOTTIC SPACE AND CERVICAL METASTASES

Primary Lesion and Nodal Findings	Thyroid Cartilage Invaded	Thyroid Cartilage Not Invaded	Pre-Epiglottic Space Invaded	Pre-Epiglottic Space Not Invaded
ENDOLARYNGEAL				
Palpable-Positive*	3)	2)	3)	2)
	) 6	) 3	) 4	) 5
Impalpable-Positive*	3)	1)	1)	3)
Impalpable-Negative*	1	8	1	8
Totals	7	11	5	13
SUBGLOTTIC				
Palpable-Positive		1		1
Impalpable-Positive	1	5		6
Impalpable-Negative		6		6
Totals	1	12	0	13
EXTRINSIC				
Palpable Positive	1 (lateral lamina)	13	3	11
Impalpable-Positive	1	7	6	2
Impalpable-Negative	1	5	4	2
Totals	3	25	13	15
ARYEPIGLOTTIC AND EPIGLOTTIC				
Palpable-Positive		3	3)	
			) 7	
Impalpable-Positive	1	3	4)	
Impalpable Negative	1	4	4	1
Totals	2	10	11	1

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* Negative and Positive denote demonstration or failure to demonstrate nodal metastases. See explanation under Classification *Definition of Clinically Palpable and Clinically Negative Nodes*

Crossed Nodal Metastases and the Location of the Primary Lesion—In order to discuss the subject of crossed or contralateral metastases, clinical follow up findings have been included Over the past eight years, in patients observed from fifteen months to eight years, crossed metastases have not been observed following resection of endolaryngeal carcinoma, but have been found in two of 20 patients operated upon for unilateral extrinsic carcinomas, and one of 10 patients operated upon for unilateral subglottic carcinoma (10 per cent) For the entire group of 55 unilateral neck dissections, secondary neck dissection on the remaining side was not necessary in any endolaryngeal carcinoma but was necessary in one subglottic and in two extrinsic carcinomas of the larynx.

Invasion of the Thyroid Cartilage, Pre Epiglottic Space and the Lateral Deep Cervical Nodes—The nodal findings in the various primary laryngeal carcinomas are tabulated with relation to erosion of the thyroid cartilage and the invasion of the pre-epiglottic space (see Table II) It was observed in *endolaryngeal carcinoma* that in the presence of thyroid cartilage erosion nodal carcinoma could be demonstrated more often than in the absence of cartilage destruction

In six of seven (86 per cent), invasion of the anterior cartilage was associated with positive nodes in the lateral cervical area. In four of five (80 per cent), invasion of the pre-epiglottic space was associated with positive nodes In four instances, invasion of both of these structures existed together in the same specimen Nodal metastasis was found in the absence of invasion of the thyroid cartilage and pre-epiglottic space but there were many negative nodal findings, eight of 11 (73 per cent), and eight of 13 (62 per cent), respectively

The pre-epiglottic space was seldom invaded in subglottic and pyriform sinus cancers In seven of 11 aryepiglottic fold and epiglottic carcinomas tumor was demonstrated in the pre-epiglottic space and in the cervical nodes (64 per cent) In only one instance of epiglottic and aryepiglottic fold carcinoma, was there absence of preepiglottic space invasion and negative nodes

Invasion of the thyroid cartilage occurred in characteristic fashion (see Figs 26, 27) Initially, the tendon of the anterior commissure was invaded followed by erosion of the thyroid cartilage Carcinoma within the cartilage was found to spread in all directions, superiorly, inferiorly, laterally and anteriorly, until the external perichondrium was invaded With further anterior extension through the external perichondrium, direct

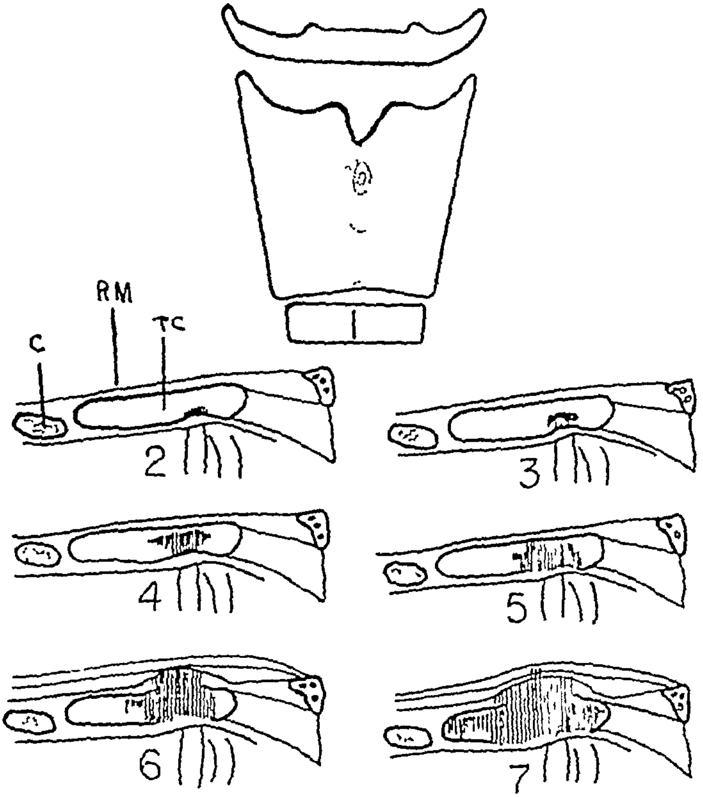

Fig 26 Invasion of cancer into the anterior thyroid cartilage 1 Anterior view of the thyroid cartilage the dotted lines show the area of progressive destruction that may be *demonstrated* 2-7 Sagittal views 2-4 Various stages of increasing destruction of the thyroid cartilage 5 Erosion into the external perichondrium of the thyroid cartilage 6 Invasion into the ribbon muscles TC—Thyroid Cartilage RM—Ribbon muscles C—Cricoid cartilage

invasion of the strap muscles anterior to the larynx occurred Erosion of the lateral thyroid ala was rarely *observed in* extrinsic carcinoma In subglottic and extrinsic carcinomas invasion of the anterior thyroid cartilage was infrequent (three of 41), and could not be correlated with *nodal* metas tases In one endolaryngeal carcinoma, invasion of the anterior thyroid cartilage was associated with an impalpable metastasis of the prelaryngeal node

Endolaryngeal and epiglottic carcinomas invaded the pre-epiglottic space readily through its apex or through the fenestrations of the epiglottic cartilage (see Figs 28, 20) Aryepiglottic fold cancers frequently invaded the lateral portion of the pre-epiglottic space

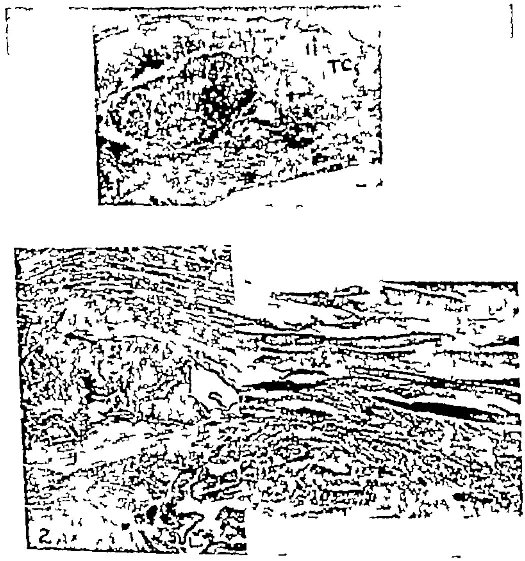

Fig 27 Invasion of the anterior thyroid cartilage 1 Note the destruction of cartilage by a large neoplastic mass; TC—Thyroid cartilage 2 Cancer has extended anteriorly into the ribbon muscles in the area indicated by arrow note the pieces of degenerating cartilage 3 High power view of ribbon muscles in the area of the arrow

The thyroepiglottic ligament and membrane is composed of thin connective tissue and elastic fibers, extending from the petiole of the epiglottis to the inner and anterior perichon dial surface of the thyroid in the region of the anterior commissure of the true cords

This membrane is quite thin and does not resist tumor invasion into this loose areolar tissue which contains lymphatic channels Whereas the median and lateral hyothyroid mem-

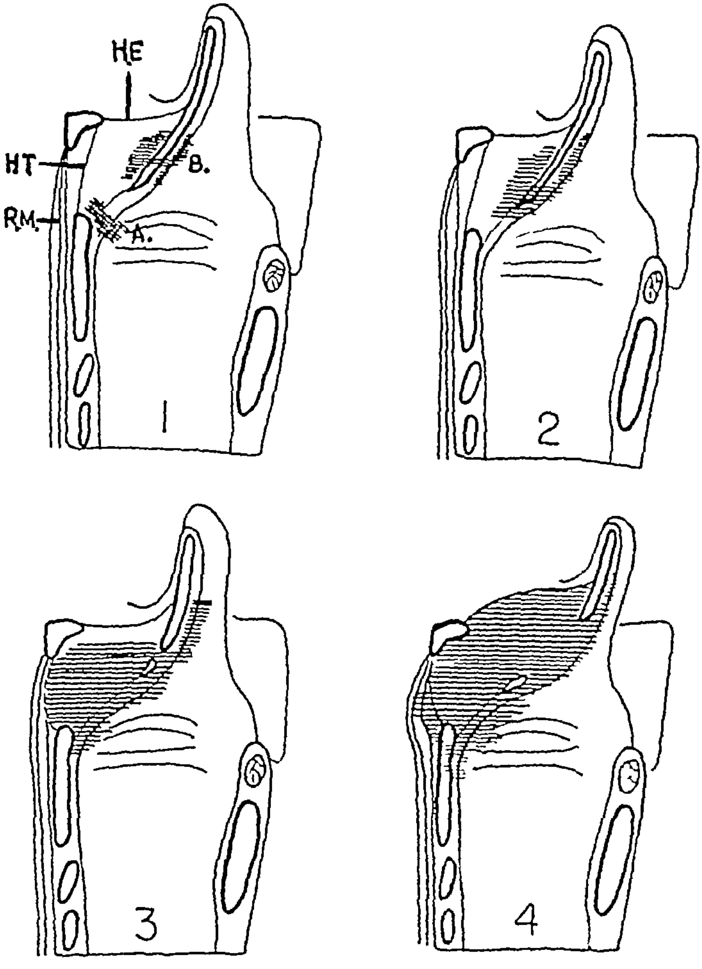

Fig 28 Invasion of the pre-epiglottic space 1 The area of (A) indicated by cross-hatching shows the common point of invasion into the pre-epiglottic space in endolaryngeal carcinoma The area (B) is the common site for epiglottic cancer 2 Invasion through the fenestrations of the cartilage 3 Extension of cancer to the anterior thyro-hyoid membrane (H T) 4 Superior extension pushes the hyo-epiglottic membrane (H E) upwards and may invade the base of the tongue note invasion of the ribbon muscles (R M)

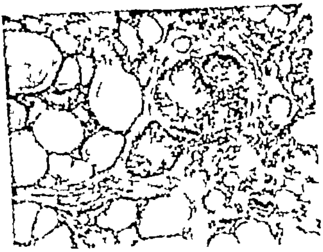

Fig 9 Tumor within vascular channels of the thyroid gland.

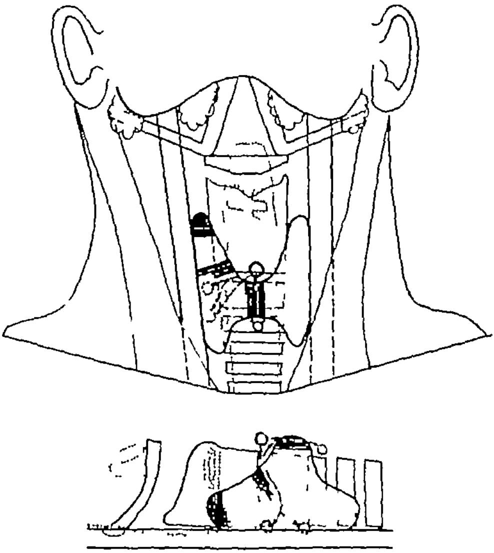

Fig 30 Thyroid gland relationship with the larynx the upper and lower schematic drawings show the areas of the thyroid gland invaded by cancer Note the intimate relationship of the superior lobe with the pyriform sinus and the isthmus, and lateral lobe with the cricothyroid membrane the dotted arrows show the direction of possible lymphatic extension. O—Prelaryngeal note ()—Paratracheal node O—Pretracheal node

brane and hyoepiglottic ligament and membrane tend to confine the tumor within this space, the pre-epiglottic space neoplasm can spread in the lateral portions of this space along the outlet of the superior laryngeal vessels into the neck In pyriform sinus and subglottic carcinomas, involvement of the pre-epiglottic space was unusual (two of 27), and could not be correlated with nodal metastases

Prelaryngeal Nodes and the Lateral Deep Cervical Nodes—In three endolaryngeal carcinomas and two subglottic carcinomas, the prelaryngeal node was microscopically positive In all five instances where the prelaryngeal node was involved,

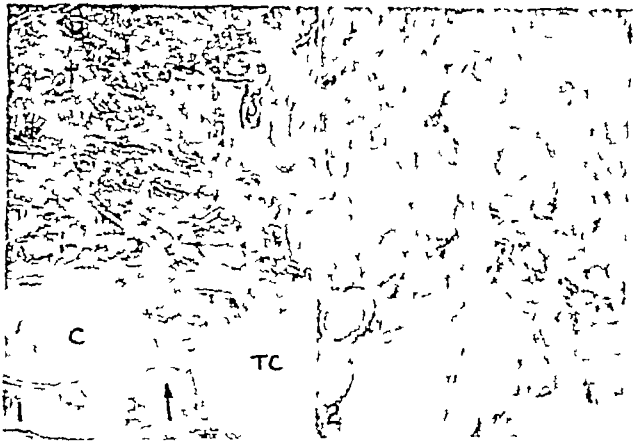

Fig 31 Invasion of the thyroid gland and ribbon muscles 1 The arrow indicates the direction of invasion through the cricothyroid area into the anterior neck 2 High power of area T T—Thyroid gland C—Cricoid cartilage TC—Thyroid cartilage

carcinoma was demonstrated in the deep cervical lymphatics (see Figs 21, 23) Two of the five were associated with small clinically palpable nodes in the cervical lymphatics, and three were associated with microscopically positive impalpable nodes in the neck The prelaryngeal node was negative in extrinsic cancers of the larynx

Other associated lesions with positive prelaryngeal nodes were one instance of thyroid cartilage invasion in endolaryngeal carcinoma, one instance of invasion of the sternohyoid muscle in subglottic carcinoma, and one instance of a metastasis in a paratracheal node

The Thyroid Gland, Prelaryngeal and Paratracheal Nodes and Sternohyoid and Sternothyroid Muscles —In two instances of *endolaryngeal* carcinoma the thyroid isthmus contained lymphatic carcinomatous emboli (see Fig 29) In one of the two with invasion of the thyroid, an impalpable metastasis of the prelaryngeal node was also present, but not in the other

In two subglottic carcinomas, tumor infiltrated the isthmus in one and the capsule of the tracheal surface of the lateral lobe of the thyroid in the other (see Figs 10, 30, 31) In one of two with invasion of the thyroid, tumor was shown to infiltrate the sternohyoid and sternothyroid muscles

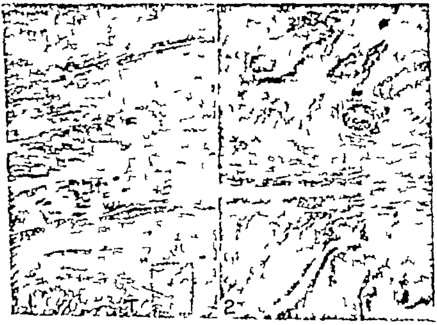

Fig 32 — Invasion of the superior lobe of the thyroid gland 1 Low power showing cancer immediately adjacent to the thyroid 2 High power view of dotted area. T—Thyroid.

The paratracheal nodes that are normally located posteriorly and medially and in close proximity to the lateral lobe of the thyroid gland were involved in two instances of endolaryngeal carcinoma In one of the above two, a positive prelaryngeal node was also present.

The capsule of the superior lateral lobe of the thyroid was invaded twice by tumor in extrinsic cancer (see Fig 32) The isthmus of the thyroid was not invaded in extrinsic carcinoma

The sternohyoid and sternothyroid muscles often referred to as the ribbon or strap muscles, were invaded in five of 59 specimens In one instance of endolaryngeal carcinoma these muscles were invaded at the point of tumor penetration through the external perichondrium of the anterior thyroid cartilage In subglottic carcinoma invasion of the ribbon muscles and thyroid gland was found in one case, and invasion of the ribbon muscles and the prelaryngeal node, in another (see Fig 33) In two epiglottic carcinomas the tumor passed through the anterior hyoepiglottic ligament to invade the ribbon muscles

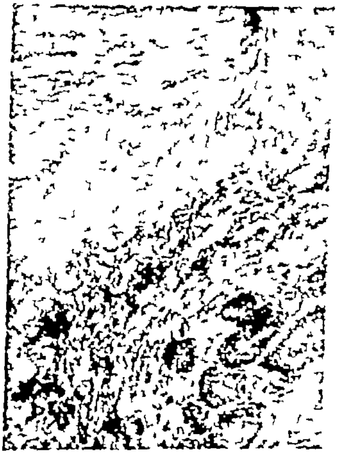

Fig 33 A focus of cancer in the ribbon muscles was accidentally found adjacent to the prelaryngeal node

DISCUSSION

The results of this study of surgical pathology of cancer of the larynx indicate that a relationship exists between the primary lesion and the likelihood of occult metastatic disease Some information has also been obtained with respect to the incidence of metastatic disease in sites not always appreciated The degree of correlation between the extent of the local disease and the metastatic disease may be altered by expansion of the series of specimens studied There is substantial agreement between comparable findings in the author's series and observations reported in the literature

Pathologic investigation of carcinoma of the larynx in the present group revealed a high incidence of widespread metastases in impalpable nodes* homolateral to the primary lesion in the extrinsic, the subglottic or the endolaryngeal areas Such wide scattering of nodes would explain lateral neck "recurrences" after laryngectomy When such nodes become clinically evident following laryngeal surgery, the low position and size of such nodes often increase the likelihood of failure of secondary neck dissections

After irradiation of the neck, wide scattering of positive impalpable nodes would explain "recurrences" at the border, or outside of the irradiated field In two patients who had previously received radiotherapy, the surgical findings supported this suggestion It becomes much more difficult, if not impossible, as impalpable nodes increase the size of the field, for radiotherapy to sterilize the tumor adequately

The high incidence of impalpable nodes has been related to surgical failure by several authors,[7 21 22 72,73,76,78 89] whose evidence indicates that demonstrably invaded impalpable nodes may explain the great majority of failures of simple laryngectomy In the writer's experience metastases in impalpable nodes in four of 13 (31 per cent) specimens of endolaryngeal carcinoma were not surprising, if one appreciates that the lymphatic supply is rich immediately above the cord Carcinoma rarely metastasizes from a mobile true cord, but in fixation of the cord due to invasion of muscle infiltration into the muscular lymphatics may lead to lateral cervical nodal metastases

Pietrantoni et al,[78] reported a high incidence of metastases from vestibular carcinoma in impalpable nodes but they gave no exact figures In their classification, vestibular carcinoma may include those involving the arytenoid Since the incidence of metastasis is unusually high when the arytenoid is involved, from their data it is difficult to determine the exact incidence of metastatic carcinoma from the false cord and the ventricular areas The demonstration of positive impalpable nodes in one-half of the number of subglottic and extrinsic carcinomas in the writer's series correlates well with the figures of 46 per cent and 58 per cent respectively reported by Pietrantoni, et al[78]

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* The discussion of impalpable nodal metastases is restricted to instances in which clinical examination of the neck was negative for nodes as described under Classification

Pietrantoni and his collaborators,[78] and Bocca[7] have related the high incidence of cancer in impalpable nodes demonstrated after elective neck dissection to eventual surgical success Pietrantoni's group[78] reported a 63 per cent five year survival for patients treated by prophylactic or elective neck dissections with laryngectomy for vestibular carcinoma and 25 per cent for laryngectomy alone

Bocca, who is a colleague of Pietrantoni, similarly reports 65 per cent five year survival for patients whose vestibular cancer was treated by prophylactic neck dissection with laryngectomy, and 25 per cent by therapeutic neck dissection The clinical reports by Sylvester-Begnis[80] and Del Sel[25] also suggest that better results are to be expected with one-stage radical surgery than by withholding neck dissection until nodes have been demonstrated, or by irradiation of nodes that are already palpable

There was a high degree of correlation between positive prelaryngeal nodes and lateral cervical metastases from *subglottic* and *endolaryngeal tumors* in the author's series, (five of five) Rouviere's[80] study of the lymphatics of the larynx and neck would lead one to anticipate progressive spread from the endolaryngeal area to the prelaryngeal node, and then to the deep cervical area, however, since the prelaryngeal metastases were microscopic or small, and those in the lateral cervical lymphatics were equally small or larger and widely dispersed, they may have occurred as essentially multiple lymphatic emboli

It is important to determine whether this high degree of correlation between positive prelaryngeal nodes and deep cervical nodes will be found in a larger series of observations It is of interest to note that prelaryngeal nodal metastasis has not been found with *extrinsic carcinoma* of the larynx, although deep cervical metastases are common Apparently lymphatic spread from sites superior to the true cord does not involve the inferiorly directed lymphatic channels which are efferent from the true cord

The observation that impalpable metastases were predominantly homolateral to the primary lesion correlates well with the infrequency of contralateral or crossed nodal metastases noted The incidence of crossed nodal metastasis in the present group was low, (none for endolaryngeal, one of 10 for subglottic and two of 20 for extrinsic cancer) too low to justify bilateral elective neck dissection with laryngectomy for unilateral carcinoma.

Palpable adenopathy has become generally accepted as an absolute indication for radical neck dissection with laryngectomy for all types of advanced laryngeal carcinoma.[7 13 21 -3,12,13, 14 15] Multiple impalpable nodes have almost invariably been found in association with palpable nodes, while direct extension from larger nodal metastases may involve the great vessels of the neck. A palpable metastasis therefore, may determine the prognosis rather than the primary site and local extension of the lesion

An important relationship exists between *endolaryngeal* lesions and the likelihood of involvement of the cartilages of the larynx and the pre-epiglottic space With invasion of these structures nodal metastases are frequent, while in the absence of this invasion nodal metastases are much less likely In the writer's series of endolaryngeal carcinoma, in six of seven (86 per cent), invasion of the thyroid cartilage was associated with positive lateral cervical findings

Similarly in four of five (80 per cent), involvement of the pre-epiglottic space was associated with positive lateral cervical findings By contrast in the absence of invasion of the thyroid cartilage, positive cervical nodes were found in three of 11 specimens (27 per cent), and in the absence of invasion of the pre-epiglottic space positive nodes were found in five of 14 specimens (38 per cent)

Broyles[13] attributes the frequency of invasion of the anterior thyroid cartilage to the intimate relationship between the cartilage and the tendon of the anterior commissure Absence of this intimate relationship lateral to this tendon may explain why direct extension of cancer through the lateral lamina of the thyroid cartilage has not been observed

The tendon of the anterior commissure is a band of fibrous tissue, measuring about one mm in width and 10 mm in length, located in the midline on the posterior aspect of the anterior thyroid cartilage, whose lymphatics and blood vessels enter the perichondrium of the thyroid cartilage

The correlation noted between nodal metastases and invasion of cancer into the thyroid cartilage and pre-epiglottic space in *endolaryngeal* carcinoma was not found in *subglottic* and certain *extrinsic* cancers An explanation may be based upon anatomical considerations In subglottic carcinoma, the tumor arises laterally beneath the true cord and reaches the anterior commissure tendon area relatively late in its evolution In pyriform sinus carcinoma, extension occurs around the lateral lamina long before approaching the anterior thyroid cartilage

The pre-epiglottic space is in intimate anatomic relationship with epiglottic, aryepiglottic and endolaryngeal cancers, whereas this space is distantly related to pyriform sinus and subglottic cancers Invasion of the pre-epiglottic space occurs relatively early from the first three sites and may occur relatively late in the latter two areas

In spite of the readily adduced explanations from anatomical considerations for extension of laryngeal cancer to the thyroid cartilage and the pre-epiglottic space, it is important to determine whether these relationships will be borne out by a larger experience because of the prognostic significance of such extensions

The thyroid gland and the ribbon muscles are in close relationship to the thyroid and cricoid cartilages and the pre-epiglottic space, and may become involved with or without invasion of the thyroid cartilage, the pre-epiglottic space or the prelaryngeal node These observations may explain many surgical failures, especially those of narrow field procedures

Since involvement of the thyroid gland was demonstrated in about 10 per cent of the writer's series, neck dissection should include *en bloc* removal of the lateral lobe and isthmus In four instances, the thyroid capsule was invaded by direct extension, and in two instances lymphatic tumor emboli were found on microscopic examination In addition, the paratracheal nodes, demonstrably involved in two instances, were readily removed only in conjunction with the adjacent thyroid gland

Invasion of the sternohyoid and sternothyroid muscles has also been demonstrated through the anterior thyroid cartilage in endolaryngeal carcinoma (once), through the cricothyroid membrane in subglottic carcinoma (twice) and through the hyo-epiglottic ligament in epiglottic carcinoma (twice)

The results discussed above provide some explanation for the shortcomings of limited surgical procedures in cancer of the larynx Evidence has been presented which indicates that more extensive radical surgery should materially improve the outlook for cancer of the larynx

SUMMARY

1 A pathologic study of 59 surgical specimens removed from laryngectomy and elective or therapeutic radical neck dissections for carcinoma of the larynx has been presented

2 Fifty five tumors (93 per cent) were characterized by ulceration fungation and deep infiltration three were exophytic, papillary structures and infiltration was minimal Fifty six tumors (95 per cent) were of the squamous cell variety and three were adenocarcinomas

3 Observations of characteristic features of the local disease were presented according to the classification of endolaryngeal subglottic and extrinsic carcinoma

In 18 endolaryngeal carcinomas, the following features were noted

1 The tumor of the true cord was localized to its anterior half for some time, and slowly invaded the false cord and ventricle, anteriorly and superiorly

2 Fixation of the cord was due to infiltration by cancer of the intrinsic muscles, and was not due to invasion of the arytenoid cartilage

3 Carcinoma as lymphatic emboli was occasionally observed in the deep local tissue

4 Invasion of the anterior thyroid cartilage was commonly demonstrated (seven of 18) Primary invasion of the lateral lamina of the thyroid and the cricoid cartilages was not observed

5 Infiltration of the pre-epiglottic space was observed in five instances Frequently, invasion of this space and of the thyroid cartilage was found in the same specimen (four of 18)

6 Involvement of the immediate extralaryngeal soft tissue structures is frequent

  a Occult metastases to the prelaryngeal node were infrequently demonstrated (twice)

  b Invasion of the thyroid gland occurred twice, and in two instances positive paratracheal nodes were in close apposition to the gland

  c Infiltration of the sternohyoid and sternothyroid muscles was found once

In 13 subglottic carcinomas the following features were noted

1 The tumor remained localized beneath the true cord and was frequently unilateral The center or origin was 0 6 to 1 0 cm beneath the cord, often the advancing margins of the tumor were submucosal, infiltration of the supraglottic area was infrequent

2 Invasion through the cricothyroid membrane was observed (three of 13)

3 Fixation of the vocal cord was due to tumor infiltration of the intrinsic muscles and not to invasion of the arytenoid cartilage

4 Lymphatic and perineural lymphatic invasion was frequently observed in the deeper subglottic tissues

5 Destruction of the anterior thyroid cartilage was unusual (once), and erosion of its lateral lamina was not demonstrated The cricoid cartilage was seldom invaded by cancer (once)

6 Invasion of the pre-epiglottic space was not demonstrated

7 Involvement of immediate extralaryngeal soft tissue structures was frequent.

  a Occult metastases to the prelaryngeal node was not infrequently found (three of 18)

  b Invasion of the thyroid gland was observed twice

  c Infiltration of the sternohyoid and sternothyroid muscle was observed twice

In 28 extrinsic carcinomas, the following features were noted

1 The primary tumor rapidly and deeply infiltrated the local area and spread laterally toward the lateral cervical lymphatics

2 Invasion of the endolarynx occurred frequently by the direct "retrograde' submucosal route, but subglottic invasion was rare.

3 Fixation of the cord, if present, was due to tumor about the perichondrium of the arytenoid cartilage and secondary invasion of the intrinsic muscles Twice the arytenoid cartilage was directly infiltrated

4 Submucosal and deep lymphatic tumor invasion was invariably demonstrated in the local lesion

5 Involvement of the pre-epiglottic space occurred very frequently with aryepiglottic fold and epiglottic cancers (11 of 12) and infrequently with pyriform sinus cancers (two of 16)

6 Invasion of the anterior thyroid cartilage was not observed, and only once was its lateral lamina invaded

7 Involvement of immediate extralaryngeal soft tissue structure is frequent.

  a Metastases were never demonstrated in the prelaryngeal node

  b The superior lobe of the thyroid was invaded twice *c* Twice in epiglottic carcinoma, there was infiltration of the sternohyoid and sternothyroid muscles This was not found in other extrinsic cancers

4 The tumors were grouped according to presence or absence of palpable nodes The following characteristics were noted for the impalpable group

1 Impalpable nodes which contained carcinoma were homolaterally demonstrated in four of 13 endolaryngeal carcinomas (31 per cent), in six of 12 subglottic carcinomas (50 per cent), and eight of 14 extrinsic carcinomas (57 per cent)

2 In all three primary lesions, carcinoma in impalpable nodes was demonstrated in all triangles in the neck, except in the submental area These nodes were equally distributed, and widely dispersed in the lateral neck

3 Such positive impalpable nodes often measured 0 5 to 1 3 cm in their longest axes

The characteristics of the palpable node group are

1 Palpable nodal metastases were demonstrated in five of 18 endolaryngeal cancers, one of 13 subglottic cancers and 14 of 28 extrinsic cancers

2 Multiple positive nodes were invariably demonstrated in association with the main palpable node

5 Crossed metastases have not been found in any of the endolaryngeal carcinomas but were found in one of 10 unilateral subglottic carcinomas, and in two of 20 unilateral extrinsic carcinomas (10 per cent)

6 Correlation between the invasion of cancer into the immediate extralaryngeal structures, the prelaryngeal node, the thyroid cartilage, the pre-epiglottic space and lateral cervical nodal metastases revealed the following

1 In every instance of endolaryngeal and subglottic carcinoma, when the prelaryngeal node was microscopically positive, cancer was demonstrated in the lateral deep cervical nodes (five of five)

2 In endolaryngeal carcinoma, invasion of the thyroid cartilage and of the pre-epiglottic space was usually associated with demonstrable cancer in the deep cervical lymphatics (six of seven or 86 per cent, and four of five or 80 per cent respectively) In the absence of invasion, there was a lower incidence of positive nodes (three of 11 without cartilage invasion and five of 18 in the absence of pre-epiglottic space invasion), with a corresponding higher incidence of negative nodal findings In subglottic and extrinsic cancers, invasion of the thyroid cartilage was rarely observed

3 In epiglottic and aryepiglottic fold carcinoma, involvement of the pre-epiglottic space was invariable (11 of 12), and was associated with a significant incidence of positive nodes (seven of 11) in the lateral neck Absence of invasion of the pre-epiglottic space was rare (one of 12), and in this instance positive nodes were not found

7 The following observations on the thyroid gland and the ribbon muscles were noted

1 Invasion of the thyroid gland was encountered in six of the 59 specimens (10 per cent) Carcinoma has been demonstrated in the isthmus, lateral lobe, and superior lobe, either as lymphatic emboli within the gland or as invasion of its capsule Positive paratracheal nodes have been found in immediate apposition to the capsule of the gland

2 Invasion of the sternohyoid and sternothyroid muscles was demonstrated in five of 59 laryngeal cancers and can occur through the anterior hyoepiglottic ligament, through an eroded thyroid cartilage, or through the cricothyroid membrane.

3 Invasion of cancer in these structures the thyroid gland and the ribbon muscles, has been occasionally demonstrated independent of involvement of the thyroid cartilage, the pre-epiglottic space and the prelaryngeal node.

CONCLUSIONS

1 A study of the three primary types of laryngeal carcinoma revealed characteristic differences of local spread and invasion The location of the primary tumor was the determining factor as to frequency of invasion of the prelaryngeal node, the pre-epiglottic space, and the thyroid cartilage

2 Differences existed between the site of origin and the incidence of impalpable metastases A high incidence of metastases was demonstrated in impalpable nodes from extrinsic, subglottic and endolaryngeal carcinomas (57 per cent, 50 per cent and 31 per cent respectively) Impalpable metastases observed in the lateral deep cervical nodes were nearly always homolateral and rarely contralateral to the primary lesion, therefore, initial accurate clinical classification of the primary lesion is extremely important

3 In endolaryngeal and subglottic carcinoma, there was a high degree of correlation between involvement of the prelaryngeal and deep cervical nodes

4 In endolaryngeal carcinoma, there was good correlation between invasion of the thyroid cartilage and pre-epiglottic space and cancer in the cervical nodes Absence of invasion of these structures does not rule out the possibility of invasion of lateral cervical lymphatics

5 In epiglottic and aryepiglottic fold cancer, invasion of the pre-epiglottic space almost invariably occurred and was associated with a high incidence of carcinoma in the cervical nodes

6 In endolaryngeal, subglottic, epiglottic and aryepiglottic fold cancers, the demonstration of tumor invasion in the prelaryngeal nodes, in the thyroid cartilage, or in the pre-epiglottic space are important prognostic findings

7 Involvement of the thyroid gland and of the sternohyoid and sternothyroid muscles occurred often enough to be considered a likely metastatic feature of cancer of the larynx

8 The results of this study on specimens removed from laryngectomy and neck dissection on a consecutive group of operable laryngeal carcinomas, which support the above conclusions, seem to warrant the following surgical considerations

a Only wide field laryngectomy will encompass the local laryngeal lesion. This surgery should include not only the hyoid bone, the first tracheal ring, all ribbon muscles from the hyoid to the sternum, and tissue lateral to the anterior border of the sternocleidomastoid muscle, but should also include the isthmus and lateral lobe of the thyroid on the side of the lesion The infrequency of invasion of the thyroid gland or the ribbon muscles does not constitute a reason for preserving these structures

b Therapeutic neck dissection with laryngectomy is mandatory but often multiple nodal involvement is demonstrated, and these nodes may determine the prognosis rather than the primary lesion

c The incidence of impalpable metastases from endolaryngeal, subglottic and extrinsic cancers is sufficiently high to justify *en bloc* elective unilateral or bilateral neck dissection with laryngectomy

d. Secondary neck dissection must be strongly considered in a specific situation If pathologic examination of the specimen from simple laryngectomy reveals metastasis in a prelaryngeal node invasion of the thyroid cartilage or the pre-epiglottic space, there is likelihood of further spread to the lateral neck.

e Because of the low incidence of crossed nodal metastasis, bilateral elective neck dissection appears to be contraindicated in every instance of unilateral carcinoma of the larynx.

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MICRO CHEMICAL STUDIES ON NORMAL CERUMEN †
I. THE LIPID AND PROTEIN CONTENT OF NORMAL CERUMEN AS AFFECTED BY AGE AND SEX

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The chemical composition of cerumen is of interest to otologists, particularly in connection with infections of the external ear A search of the literature on the subject, however, produced very little information. Most of the work reported[1,2,3] was performed on pooled samples, a procedure made necessary because of the small quantity of cerumen that could be obtained from each subject. With micro-techniques it is now possible to analyze samples as small as 0 2 to 0 3 mg[4] It is the purpose of this paper to report modifications of these micro-techniques for the study of individual samples of cerumen in order to obtain a clearer picture of their clinical composition The lipid, protein, and non-lipid non protein content of normal cerumen from subjects of various ages and of both sexes are presented here in order to ascertain whether a relationship between age and sex and these constituents exists

MATERIAL AND METHODS

One hundred and twenty individual samples of cerumen were removed with a curette from the ear canals of clinically normal subjects and preserved in a deep freeze until time of analysis

The samples were weighed in the following manner Paper

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cleansing tissue which had previously been extracted with redistilled ethanol was cut into approximately 1/3 to 1/2 cm squares and weighed on a quartz fiber micro balance, 200 to 600 micrograms of the samples were smeared onto the center of the tissue and wrapped tightly in order to prevent any undissolved particles escaping into the solvent during the extraction of the lipid The wrapped wax was then dried under vacuum for 30 minutes and weighed to obtain the dry weight

Total lipids were estimated by the loss in weight after extraction with redistilled ethanol After three extractions the residue remaining in the tissue was dried and weighed again, the loss in weight being taken to represent the amount of the total lipids The protein content was measured on the residue left after lipid extraction using a colorimetric method[5]

The alcoholic extract was taken to represent the total lipid despite the fact that a portion of the free amino acids was usually extracted along with it Analysis for amino acids, however, showed that the extracts contain only 2 0 to 3 5 per cent amino acids

RESULTS AND DISCUSSION

Tables 1 and 2 illustrate examples of results obtained in analyses for total lipids in pooled and individual samples

Data for the 120 individual samples classified according to age and sex are presented in Table 3 The results show no significant difference in lipid and protein constituents between the two age groups of children nor is there any indicated between the sexes When data for the adults and children are compared, the children are found to have slightly higher lipid and lower protein values, but the difference is not statistically significant Among the adults there is little variation in lipid or protein content in relation to either age or sex Good consistency is shown in both fractions

There is marked individual variation among the samples of the same age group as shown by the values of standard errors (see Table 3) The results varied with different samples In some cases a precision of better than 1 to 2 per cent was obtained whereas in others the range extended to 10 to 15 per cent The non-uniformity of a considerable number of

TABLE 1.

DETERMINATION OF TOTAL LIPID IN POOLED SAMPLES *

Sample No.	Tissue Wt.	Tissue + Sample Wt after Drying	Sample Wt.	Tissue + Sample Wt. after Extraction	Loss in Wt.	% Lipid	Av	Precision
Tissue Paper	727	727	—	727	—	—		
Sample I	908	1124	216	1029	95	44.0		
	1038	1605	567	1342	263	46.4		
	1142	1815	673	1500	315	46.8		
	1232	1715	483	1495	220	45.6		
	1415	1965	550	1705	260	47.2		
	1205	1750	545	1505	245	45.0	45.8	021
Sample II	696	868	172	801	67	38.7		
	696	886	190	819	67	35.3		
	656	797	141	749	48	34.1		
	589	793	204	722	71	34.8		
	639	1128	489	953	175	35.8		
	678	868	190	801	67	35.3	35.7	038

All the weights are in micrograms.

TABLE 2

DETERMINATION OF TOTAL LIPID IN INDIVIDUAL SAMPLES *

Sample No	Tissue Wt	Tissue + Sample Wt after Drying	Sample Wt	Tissue + Sample Wt. after Extraction	Loss in Wt	% Lipid	Av	Precision
N 250	718	1034	316	859	175	55 4		
	643	949	306	779	170	55 6	55 4	0 0037
	639	962	323	784	178	55 1		
N 273	806	1011	205	921	90	43 9		
	779	998	219	903	95	43 4	43 8	0 0053
	731	1038	307	903	135	44 0		
N 271	775	1052	277	886	166	60 0		
	810	1029	219	899	130	59 4	60 0	0 0055
N 277	886	1115	229	1011	104	45 4		
	678	1065	387	890	175	45 2	45 4	0 0029
N 295	771	1038	267	846	192	71 9		
	788	1097	309	877	220	71 2	71 4	0 0016
	903	1205	302	989	216	71 1		

* All the weights are in micrograms

TABLE 3

LIPID AND PROTEIN CONTENT OF NORMAL CERUMEN

Age	Sex	No of Subjects	% Lipid	S. E.	% Protein	S. E.	% Non lipid Non protein
1-7	M	13	50.4	4.4	21.0	2.3	28.6
	F	12	59.7	6.0	17.2	.9	23.1
8-13	M	6	62.2	11.6	16.6	3.3	21.2
	F	7	71.1	8.3	10.0	2.6	19.0
14-25	M	7	53.3	5.5	21.2	2.8	25.5
	F	13	47.9	12.1	22.7	1.7	29.4
26-40	M	10	49.8	3.5	22.2	3.1	28.0
	F	10	52.1	11.3	24.8	3.4	23.1
41-60	M	16	42.7	2.5	33.8	2.0	23.4
	F	8	46.9	6.5	26.4	4.8	28.7
Over 60	M	7	49.6	2.9	25.3	2.3	25.2
	F	11	52.1	3.4	23.7	1.5	24.2
Children 1-13	M	19	54.1	5.1	19.6	1.9	26.3
	F	19	63.8	1.3	13.7	3.2	22.5
Adults Above 14	M	40	47.9	1.9	23.1	1.1	22.5
	F	42	49.8	1.73	24.4	1.3	25.3

the samples is one of the most difficult problems and may be a result of the fact that ear wax is a very heterogenous mixture. Mixing the samples before weighing helps somewhat, but still it is very difficult to obtain uniform samples, therefore when the size of the sample permitted, as many as five or six determinations were performed and the average taken. Wheatley[6] in his study of sebum-like materials of human origin made similar observations regarding cerumen samples.

The nature of the non-lipid non-protein fraction is not yet determined. One possibility is that the unsaturated components of the lipid, on standing in the ear canal, may undergo polymerization, oxidation, or both, thus rendering them unextractable by solvents and lowering the lipid content. The non-lipid non-protein fraction may possibly be used to indicate the degree of freshness of the sample.

The relatively high lipid findings in children disagrees with the widely accepted fact[7] that the amount of fat secreted onto the surface is less in childhood, rises rapidly with the onset of puberty and then levels off to stationary adult values thereafter. The distribution of apocrine and sebaceous glands in the skin lining the ear canal differs from that of skin of the other parts of the body and may partially explain the variations in our findings.

Of significance is the tendency for ear wax to be retained in the ear canals of adults over long periods of time. This occurs less frequently in children. Since the cerumen collected for this study was taken as it occurred in the external ear canal, skin debris, hair follicles and some foreign material were found. These *non-secretory* substances when present in appreciable amount would influence the percentage of the components.

No definite conclusions have been reached with regard to the effect of age and sex on the fat content of the skin of the adults. Emanuel,[8] Kvorning,[9] and Kirk[10] have indicated that in women there is a significant drop in sebaceous secretion in the older age groups whereas in men no change is observed. A similar trend in the fat content of human hair is demonstrated by Nicolaides and Rothman.[11] Iversen, Videback and Kirk,[12] however, reported that *no* significant correlation was noted between age and sex and casual lipid levels on the forehead and on the back of the hand Our data in the ear canal seem to agree with the findings of Iversen, et al

Methods are now being sought to collect freshly secreted samples in an effort to circumvent contaminations and changes in cerumen which may occur from prolonged stay in the ear canal

SUMMARY

1 With the use of micro-techniques modified for this study, a total of 120 individual samples of cerumen were analyzed for lipid and protein content.

2 The results analyzed according to sex and age indicate that children have slightly higher lipid and lower protein content than the adults but this difference is not statistically significant.

3 Among adults there is little variation in lipid or protein content according to age

4 There is no significant difference according to sex in either children or adults.

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THE DR CHARLES BRAMMAN MEDING AWARD

On the evening of October 28, 1955, The Harlem Eye and Ear Hospital bestowed upon Dr Franz Altmann the Dr Charles Bramman Meding Award

This award is granted annually to the person judged to have made an important contribution for the advancement of Otolaryngology and/or Ophthalmology

Dr Altmann's film, "Embryology of the Ear," was considered an outstanding achievement It was shown at the hospital auditorium coincident with the presentation of the award

THE MANAGEMENT OF SOFT TISSUES IN TEMPORAL BONE SURGERY *

KENNETH MCASKILE, M D ,

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The craftsman there, the smith with that metal of his, with these tools, with these cunning methods—how little of all he does is properly his work All past inventive men work there with him as indeed with all of us in all things"[1]

Temporal bone surgery has reached a high state of perfection in recent years This has largely been due to improved techniques, better illumination and magnification the electrically driven high speed drill and the antibiotics With ever increasing knowledge of the physiology and the pathology of the ear, otologists today are striving to maintain or improve the function of the diseased ear as well as to eradicate the pathology

To accomplish this it is necessary to preserve the essential functioning anatomy of the middle ear, and by various plastic procedures reconstruct the available tissue in such a manner that the health and function of the ear will be maintained Many of our failures are the result of improper management of the soft tissues rather than the result of inadequate surgery

Throughout the past nine years, the essential details of soft tissue management have been of special interest to me This has included competent instruction, witnessing the surgical treatment in skilled hands, many trials and errors on the cadaver and personal experience with 1,500 cases The difficulties and failures have all been carefully assessed and certain principles have been accepted as those most likely to bring a successful clinical result. It is indeed the attention to detail and the respect for the function of the various structures that will make this possible

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To say that many new ideas are involved would be incorrect, for this is not a primary research problem The literature and many distinguished authors are quoted, but the surgical technique advised and discussed is that which I use personally, and the results have been assessed solely on this material The tissues to be considered are the skin, subcutaneous tissue, muscle, perichondrium, cartilage, periosteum, endosteum, dura and facial nerve

Utmost care must be exercised to avoid unnecessary trauma to the tissue during surgery Trauma can be minimized by

1 Gentle handling of all tissues
2 Adequate illumination and exposure
3 Proper magnification
4 Maintenance of a dry surgical field
5 Intimate knowledge of the anatomy
6 Sharp surgical instruments

In all temporal bone surgery, preparation of the surgical field is an important factor, and especially so in surgical procedures which are performed for non-infective pathology, such as the fenestration operation for otosclerosis and the destruction of the membranous labyrinth in Meniere's disease

The night before surgery the hair is shaved for one inch around the ear The ear and surrounding skin are carefully cleansed with Vel, then washed with alcohol, 1/1000 tincture of Zephiran is instilled into the external canal and the shaved area is painted with the same solution The entire area is covered with a sterile mastoid dressing With the exception of shaving, this procedure is repeated on the operating table

The use of adequate amounts of a suitable antibiotic preoperatively and postoperatively does much to reduce tissue reaction In infective surgery the proper antibiotic can be selected by bacteriological sensitivity tests In non-infective surgery the antibiotic of choice is penicillin It is necessary, however, to determine if the patient has any drug idiosyncrasies This can frequently be ascertained by a careful history

SIMPLE MASTOIDECTOMY

In 1928 Lempert advocated the endaural approach for the simple mastoidectomy Since that time many articles have been written, praising and condemning the endaural simple mastoidectomy For the following reasons I feel the post-auricular approach is still the method of choice

1 More direct access to the mastoid cells

2 The auricular cartilage is not exposed to the virulent infection which is usually present, and the development of a perichondritis is less likely

3 Recurrent mastoiditis following the endaural incision may cause a bulging into the external canal making examination of the tympanic membrane nearly impossible It is then difficult to differentiate between an external otitis, furunculosis or a recurrent mastoiditis

The post auricular incision is made a quarter of an inch posterior to the attachment of the auricle to the head, through the skin and soft tissue down to the bone The temporal muscle must be avoided at the upper end of the incision The skin and periosteum are then elevated anteriorly and posteriorly

Using sharp dissection with scissors, part of the attachment of the sternocleidomastoid muscle to the mastoid process is removed In elevating the skin and periosteum anteriorly damage to the tissues of the external canal must be avoided or atresia of the canal may result. Bleeding from the soft tissue is then controlled either by tieing the vessels, or with electro-coagulation

If coagulation is used, particularly near the skin surface, it must be minimal or undue damage to the tissue will result A post-auricular retractor is inserted and opened carefully Following complete exenteration of the diseased cells, all loose bone chips are removed The post-auricular retractor is removed and again bone fragments are searched for on the soft tissue and removed

The usual procedure is to suture the upper two-thirds of the post-auricular incision and insert a rubber drain into the lower end In 1906 Reik[3] allowed the mastoid cavity to fill completely with blood clot and then sutured the entire incision Failures were frequent because of recurrent infections Florey and Florey[4] introduced perfusion of the cavity with penicillin solution Reading[5] advised allowing a clot to fill the cavity, then suturing completely

Cawthorne[6] states that during the past 12 years he has stitched up the post-aural wound without any artificial drain, and every case has dried up quickly with early healing of the tympanic membrane and return to normal hearing Recurrent infection is controlled by the use of the proper antibiotics given systemically The external canal is packed completely with a strip of gauze ribbon soaked in alcohol By this method there is rapid healing of the post-auricular incision and cessation of discharge from the tympanic membrane

Reading[5] states, "The more complete the opening of the cells and removal of the endosteum has been, particularly in the region of the aditus, and the less the postoperative clot has been interfered with by drains or irrigation, the greater the chance of obtaining complete obliteration of the cavity down to the level of the aditus" This method should prevent recurrent mastoiditis, which is stated to be about 10 per cent of all operated cases of acute mastoiditis

During the last two years I have used the complete closure method on six simple mastoidectomies with healing of the post-auricular incisions by primary intention and with rapid healing of the tympanic perforations The same post-auricular incision followed by complete closure has also been used in 12 cases of destruction of the labyrinth for labyrinthine hydrops, and in nine cases of decompression of the facial nerve in Bell's palsy, and all have healed by primary intention

SURGERY OF THE CHRONICALLY DISCHARGING EAR

Under this heading will be included the complete radical mastoidectomy and the modified radical mastoidectomy The object of this surgery is

1 To remove the pathology and to prevent any progression of the disease which might endanger the patient's life

2 To preserve or improve the hearing

3 To obtain a dry ear

4 To obtain a cavity which is entirely lined by squamous epithelium, which has no hidden recesses and which is easily visible through an enlarged meatal opening

The type of operation performed will depend upon the pathology, the hearing, and the presence of complications or threatened complications Day[7] states, "make the operation fit the patient. Do not make the patient fit the operation"

The conservative type of radical mastoid surgery associated with such men as Jansen, Corner, Barany, Heath, Bondy, Siebenmann, Ballenger Richards Dench and Blackwell did not become popular with otologists until after 1938, when Lempert[8] reported his endaural approach Since then numerous articles have appeared on this subject indicating the value of conservative operations and the needless destruction of function by more radical procedures

Failure to achieve the objective stated above by competent otologists is more frequently due to faulty handling of the soft tissues than to inadequate bone surgery Competence in bone surgery can be acquired by laboratory exercises on the cadaver, however, competence in soft tissue management can be acquired only by practicing on the cadaver observing the procedure in skilled hands and then conscientiously attempting to accomplish what has been observed

It is only by diligently following these operated cases over an extended period of time that one is able to observe what eventually happens to the skin graft that was used, the perforation in the tympanic membrane the tympanomeatal flap and the meatal opening These things cannot be learned from the cadaver

Unfortunately the resident surgeons in otolaryngology are more interested in the surgical techniques carried out in the operating room than in the postoperative care in the follow-up clinics This may be due to the relatively short length of time available to them during their training in the hospital In my experience, residents who have gone into practice from our training course have had their chief concern from soft tissue complications such as stenosed meatuses and granulations under the conchal margin, rather than from improper bone surgery By observing the end results, one is able to correct mistakes made on the operating table and during the early post-operative treatment

THE INCISION

The essential of a satisfactory incision is that it should provide the most direct approach to the disease process This is accomplished by a post-auricular incision in the simple mastoidectomy In the majority of chronic discharging ears the pathology is primarily located in the middle ear, the attic and the mastoid antrum, and is best approached by the endaural route Many competent otologists still prefer to use the post-auricular route, claiming that they can accomplish the same results with the same ease as otologists using the endaural approach

The direct accessibility and good visibility of the endaural approach enable the operator to examine both the anatomy and the changes produced by disease in a minute fashion, and to apply the most refined technique in handling the structures As a result it is possible to preserve the function of the auditory organ, which is a pronounced feature of the technique[6]

In certain cases where complications are present or anticipated, or where there is a particularly large cellular development of the tip or retrosinus area, the endaural incision can be combined with a post-auricular incision At the completion of the operation the post-auricular incision is closed completely and the post-operative treatment is carried out through the endaural incision

TECHNIQUE

The operative site is prepared as described previously In addition the left thigh is prepared the day previous to the operation, in case a skin graft is required This assures a sterile donor area and saves considerable time and confusion during the actual operation

ANAESTHESIA

General anaesthesia is used exclusively for suppurative temporal bone surgery, unless definitely contraindicated An endotracheal tube is employed in a closed system, which permits the use of electro-coagulation without danger

PREPARATION AND DRAPING

The sterile dressing is removed and the operative site is again scrubbed with a solution of Vel The excess solution is removed from the external canal by suction and tincture of Zephiran instilled The ear and surrounding area are then painted with 1/1000 tincture of Zephiran

FIG. 1. Photograph demonstrating a sterile method for fixation of the head in temporal bone surgery A strip of two inch adhesive is placed over a sterile towel, passing just above the ear and fastened securely to each side of the operating table

The positioning and fixing of the head is of utmost importance and should always be done by the operating surgeon Improper position of the head makes the surgical procedure unnecessarily difficult and dangerous If the surgeon uses the same position of the head for all surgical procedures on the temporal bone, it facilitates the recognition of the surgical landmarks and makes illumination and magnification of the operative site much easier

Once the head is in proper position it can be maintained by the use of a two-inch strip of adhesive placed across a sterile towel just superior to the ear, and fastened to each side of the operating table The sterile towel is then folded back over the adhesive, leaving a sterile field The draping is completed by using three sterile towels placed in such a manner that the ear is centered in a small triangle The patient is entirely covered with a large green sheet, leaving only the ear exposed

Fig 2 Photograph demonstrating the sterile towel folded back over the adhesive with the head firmly fixed in the proper position

THE ENDAURAL INCISION

A solution of saline and adrenalin is infiltrated carefully in the following regions to produce hemostasis

1 Anterior to the helix about 2 cms superior to the external meatus, first under the skin and then down through the temporal muscle to the periosteum

2 Post-auricularly at the level of the external canal one injection is made subcutaneously and then extended down to the periosteum Using the same site of entrance the needle is then directed upwards and anteriorly towards the superior aspect of the external meatus and finally downwards and anteriorly to the inferior aspect of the canal

3 The rim of the external canal is injected superiorly, inferiorly, anteriorly, and posteriorly

These injections are made gently, and at no time should the tissues be ballooned out, as this causes unnecessary trauma.

Using a No 15 Bard Parker blade, a superficial incision is made just deep enough to make a line immediately anterior to the helix extending from a point between the tragus and the anterior crus of the helix. The ear is grasped between the index finger and the thumb of the left hand and moved gently upwards and backwards This maneuver is repeated several times to determine exactly the anterior border of the conchal cartilage which can be seen moving under the skin

With the ear held under slight tension upwards and backwards, a curved incision is made down to the bone approximately 6 mm deep to the margin of the conchal cartilage This incision begins at the inferior wall of the external canal and extends upwards in a curved fashion and is carried forward just below the incisura for 4 mm The blade is then rotated at a right angle, and a more superficial incision is carried out through the incisura along the line previously marked anterior to the helix. The incision is made more superficial in its upper part to avoid cutting into the temporalis muscle which would cause unnecessary bleeding

It is important, however, that the incision around the external meatus should be down through the periosteum Using an elevator the fascia is stripped from the temporal muscle anteriorly and posteriorly, then the exposed muscle is freed on its under surface and pushed upwards The skin and periosteum are elevated posteriorly and inferiorly over the mastoid process.

Using a curved Mayo s scissor with the curve pointing forward, one blade is placed inside the membranous external canal, the point touching the anterior canal wall, while the point of the other blade is placed on the bony rim of the meatus The upper part of the membranous canal is then cut open with a single cut This procedure is then repeated inferiorly to form the outer portion of the meatal flap

A Sullivan three-bladed self-retaining endaural retractor is placed in position, revealing the temporal muscle superiorly, Macewen's triangle posteriorly, and the meatal flap anteriorly The two lower blades of the retractor are opened gently until the desired exposure is obtained The third blade is hooked under the temporal muscle which is pulled upwards to the desired level

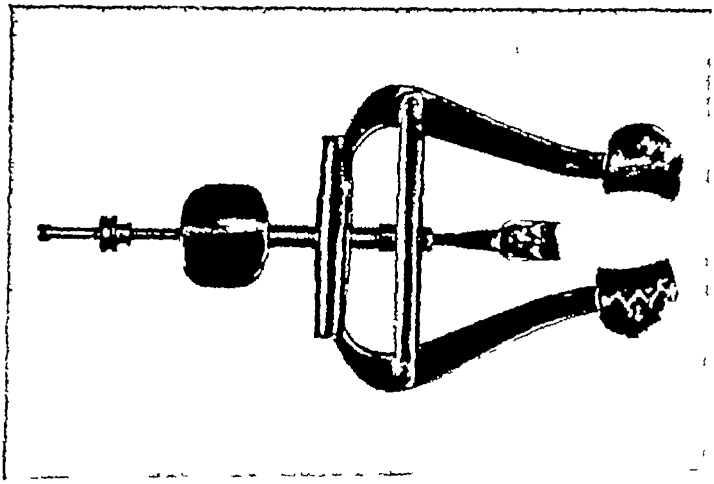

Fig 3 Sullivan three-bladed self-retaining endaural retractor The blade to suspend the temporal muscle can be adjusted independently of the other two blades

It is rarely necessary to stop any bleeding during this procedure, as it is controlled by the injections and the pressure of the endaural retractor If any undue amount of bleeding occurs it can be easily controlled by a coagulating current, however, this should be used carefully to avoid devitalizing more tissue than is necessary

The same incision is used for the complete radical mastoidectomy, the modified radical mastoidectomy, and the fenestration operation In the complete radical mastoidectomy the tympano-meatal flap is not required as such, but it can be removed when the decision is made to do the complete radical operation This sometimes cannot be determined until a careful examination of the epitympanic space, the tympanic membrane and middle ear has been done, after the meatal flap has been laid back in the exenterated mastoid cavity This serves three purposes

1 A greater number of modified operations can be done because a better evaluation of the pathology can be made at the end of the operation after all areas have been exposed and examined

2 If the complete radical is done the tympano meatal flap can be saved in its entirely and used as a free skin graft

3 It gives the surgeon added skill and experience in the creation of the tympano-meatal flap, which has been one of the great advances in temporal bone surgery[10]

After the endaural retractor has been placed in position and opened the desired amount to give adequate exposure, the tympano-meatal flap is created To obtain better visibility of the external canal and the tympanic membrane the following two steps are important the subcutaneous tissue from the outer portion of the membranous flap is removed with sharp scissors to eliminate the cerumen glands and hair follicles and reduce the bulk of the flap The upper and lower incisions made previously with the scissors are extended a short distance to give greater mobility and allow the outer part of the flap to be pushed posteriorly so the entire external canal and tympanic membrane can be visualized

Using a No 15 Bard Parker blade, an incision is made at 6 o'clock along the floor of the external canal, extending from a point approximately 4 mm external to the tympanic membrane out to the previous incision made at the lower part of the canal This incision must be made under direct vision, so the tympanic membrane will not be damaged It should be done with a single cut directly down to the bone so a sharp, clean incision is obtained

The next incision is made at 3 o clock on the anterior canal wall, extending from a point approximately 3 mm from the tympanic membrane, out to the edge of the bony portion of the canal, but not into the membranous canal It is then curved upwards to join the upper incision at 12 o'clock This incision is best made with a long handled, small curved knife

Great care must be exercised to avoid cutting into the membranous portion of the anterior canal wall, as it makes the elevation of the anterior portion of the flap very difficult Cartilage would also be unnecessarily exposed and damage to the temporo-mandibular joint might result

The membranous flap is separated from the underlying bone, using a fine elevator with a slightly curved tip The curved tip is directed towards the bone to prevent perforation or tearing of the flap Two areas are usually difficult to separate, one along the tympano-mastoidal suture line and the other at the anterior meatal spine The flap is elevated on either side of these areas and then, using sharp dissection with small straight scissors, the fibrous bands are cut as they are encountered, thus avoiding forceful dissection which could easily result in damage to the membranous flap

If the anterior meatal spine is large and projects into the canal, it should be removed with a 00 curette as soon as the skin is elevated over it to allow direct vision in elevating the remainder of the skin on the anterior canal wall It will be noted that the flap is very thin anteriorly, but fortunately it can usually be elevated with little difficulty The separation is continued down to the annulus posteriorly and superiorly This can be determined by feeling the elevator slip over the edge of the annulus into the middle ear

The flap is thinned as much as possible, using a small curved scissors and a fine-toothed forcep It is of great importance that no tension whatever be put on the flap while it is being thinned or it may be torn from its attachment at the annulus Both sides of the flap must be kept in view to prevent perforating, and only the tissue which is to be cut away is grasped with the toothed forceps After the thinning is completed the flap is placed against the anterior canal wall and held there by three separate pieces of paraffinized silk Three things are accomplished by this

1 The flap is held anteriorly to give better exposure and allow direct attack on the bony canal

2 It prevents damage to the flap while the bone work is being performed

3 It keeps the flap free of bone particles

The flap is cut, elevated and packed forward at the beginning of the operation for the following reasons

1 It allows direct access to the attic or antrum

2 The posterior bony wall can be removed with greater speed and with less chance of damaging the membranous lining

3 Bleeding along the lines of incision will have stopped by the time the bone work has been completed This is of particular importance in the fenestration operation where it is important to have no bleeding points after the fenestration has been made

THE RADICAL MASTOIDECTOMY

When it becomes obvious, because of the pathology present, that a complete radical mastoidectomy must be done, the meatal flap is removed in one piece as close to the tympanic membrane as possible. It is placed on a piece of gauze and kept moist until the bone surgery is completed The tongue of skin remaining on the anterior and inferior wall of the canal is removed completely to allow thinning and lowering of the bony canal flush with the floor of the middle ear

The remnants of the tympanic membrane are removed This may be used to put in the Eustachian orifice.[7] Before proceeding with any surgery in the middle ear it is necessary to identify the horizontal semicircular canal, the cochleariform process and the Fallopian canal This can be accomplished by using a small elevator, a fine suction tip and good illumination and magnification The thickened muco-periosteum and granulation tissue is elevated over the horizontal canal in a posterior to anterior direction.

The facial nerve will be identified in its tympanic portion just anterior to the horizontal canal It must be remembered, however, that in markedly diseased bones, particularly if cholesteatoma is present, the horizontal canal may be eroded and the facial nerve exposed, even with no history of vestibular disturbances or evidence of facial nerve involvement

Lempert,[11] states, "In order to obtain a dry ear it is necessary to remove all pathological processes encountered, any one of which when not removed could perpetuate the middle ear discharge" The thickened muco-periosteum must be removed from all areas in the middle ear This requires exenteration of the peritubal cells, and careful removal of the granulations around the stapes and round window niche

The stapes must not be dislocated if cochlear function is to be preserved and unnecessary danger to the patient's life avoided The granulations in the region of the stapes should be removed in a posterior to anterior direction so protection will be given to the stapes by the stapedius tendon[15] After the granulations are removed the tendon of the stapedius should be cut to give better mobility to the stapes[15] and improve function

The removal of granulations from the area of the round window niche can only be successfully accomplished if the posterior bony canal wall is lowered flush with the fallopian canal This removes the bony projection over this hidden area, allowing safe removal of all the diseased tissue without fear of damage to the facial nerve

It is also necessary to remove the tensor tympani muscle This can be accomplished by using an S S White No 12 dental excavator The cochleariform process is fractured off exposing the muscle The excavator is placed under the tensor tympani muscle, which is completely evulsed from its canal by elevating it in an external inferior direction away from the Fallopian canal

After the bone surgery has been completed all the bleeding points must be controlled The entire cavity is flushed with peroxide solution which whitens the cavity and floats out small bone particles Bleeding in the middle ear can usually be controlled easily by applying cotton pledgets soaked in

1/1000 adrenalin Small, troublesome bone bleeders are readily stopped by lightly drilling over them with a large diamond burr

The endaural retractor is taken out, and all the bone chips are carefully removed from the soft tissues by irrigation and suction This is important, because if these bone fragments are left they cause a foreign body reaction and produce granulation tissue which keeps the cavity discharging and prevents epithelialization Any bleeding from the soft tissue is controlled by coagulation and the retractor is re-inserted The Eustachian tube is packed with gelfoam to block the Eustachian tube and support the skin graft. X

The skin which was previously salvaged from the meatal flap is thinned carefully and used as a skin graft in the middle ear This is held in place with paraffin mesh packing This graft is done at the original operation, because it prevents the formation of granulations which, at a later date when they scar down, can cause fixation of the stapes and round window with resultant loss of cochlear function, and also because the meatal skin is available If the hearing function is not to be considered, a secondary skin graft, ten days following the original operation when a layer of granulation tissue has formed over the bone, has a better chance of survival

A thin graft is preferable for two reasons *1* It requires less nourishment to survive and will exist in an infected area where a thicker skin graft would die and slough out. *2* It preserves the function of the oval window and round window niche, because it does not undergo retraction and scarring with fixation which would be expected from a thicker graft It has one disadvantage, however, and that is its tendency to float out of position when fluid collects beneath it. This does not happen with a thicker graft.

Thin grafts can be handled easily by placing gelfoam over the graft, cutting to the desired size and then placing in position while still attached to the gelfoam This allows for careful positioning and protects the graft when the packing is removed six or seven days later The graft can also be handled in the following manner A pattern is made of the approx imate amount of skin that is required to cover the mastoid cavity A piece of paraffin mesh is moulded into the middle ear, removed, and then placed on the shaped skin graft

Using the mesh as a carrier the graft is then applied to the cavity by fitting the moulded paraffin mesh again into the middle ear This gives close approximation of the graft to the middle ear The remainder of the graft is then packed into place avoiding pressure to the region of the facial canal This is done by placing a second paraffin mesh pack posterior to the facial canal and parallel to it The third pack is placed superior to the horizontal canal extending from the antrum to the sino-dural angle

By this method no packing is placed directly in contact with the facial canal In putting a skin graft in the mastoid cavity, puckering and folding of the graft should be avoided This can be accomplished by using a pattern of the cavity to shape the graft, or by using several smaller pieces of skin placed in apposition to cover the cavity completely Just enough packing is used at this time to keep the graft in position

Attention is now paid to the meatal opening and methods of keeping it the proper size with a minimal amount of post-operative care and discomfort to the patient. In our series of cases the two commonest causes for continued discharge following temporal bone surgery, whether for suppurative or non-suppurative conditions, were post-operative narrowing of the meatus and the presence of granulation tissue underneath the conchal margin on the soft tissue between the conchal margin and the bony cavity Both these conditions can be avoided by proper management of the meatal opening at the completion of the operation and during the early post-operative period

Lempert[8] advises the removal of a triangular piece of skin to widen the meatus Sullivan[12] removes a triangular piece of periosteum under the conchal margin to allow the skin margin to turn inwards Shambaugh[13] advocates splitting the upper end of the incision several times during the early post-operative period Scharfe[14] and others have used acrylic and tantalum obturators in the meatus to prevent stenosis

These methods prove effective in the majority of cases, however, frequent post-operative examinations are required over a prolonged period to insure an adequate meatal opening and to remove or treat granulation tissue under the conchal margin If narrowing of the opening occurs, the treatments are difficult and usually quite painful to the patient.

The post-operative contractures and the granulation tissue formations are due mainly to the presence of raw surfaces of soft tissue and bone, which are left exposed at the completion of the operation The following method has been devised to avoid leaving any raw areas exposed the endaural incision is made at least 6 mm deep to the anterior border of the conchal cartilage This insures that the conchal cartilage will not be exposed during the operation, and also allows sufficient skin to cover the conchal margin and avoid persistent granulations and the possibility of perichondritis

When the bone surgery has been completed the endaural retractor is removed, the bleeding is controlled, and all free bone particles are removed Using No 000 catgut on a curved needle, the posterior margin of the endaural incision is sutured to the periosteum This is done by first placing the suture through the periosteum at the margin of the bony rim of the mastoid cavity and then just under the skin at the posterior margin of the endaural incision.

Usually four such sutures are sufficient to invert the skin margin and fix it so there will be no raw soft tissue surface posteriorly The upper part of the endaural incision is sutured in a similar manner to the temporal muscle. When this has been completed the only raw area remaining is a triangular space anteriorly, just superior to the tragus This area is covered by suturing the skin margins of the triangle together with No 00000 Dermalon A thin skin graft is placed in the mastoid cavity to cover all the exposed bone and is allowed to overlap the skin margins of the endaural incision It is not necessary to suture the skin graft to the margins, as the packing is sufficient to keep it in the proper position

This method produces a completely skin-covered meatal opening and mastoid cavity Because there are no raw areas left to permit scarring to take place the meatal opening will remain almost the same size when healing is completed Although this procedure may appear cumbersome and time-consuming in an already lengthy operation, the post-operative treatment period is markedly shortened, and patient discomfort is greatly reduced, as painful methods to prevent meatal stenosis are not required

The mastoid cavity is packed with paraffin mesh which has been impregnated with an antibiotic ointment Topical neomycin ointment has been found to be very efficacious in preventing infection and undue odor from the packing The margins of the meatus are painted with Whitehead's varnish to prevent wetting and excoriation of the skin by the discharge which may ooze from the packing The ear is coated with neomycin ointment which prevents secondary infection and keeps the dressing from sticking to the ear when it is removed in seven days

MASTOID DRESSING

A doughnut or ring of gauze is placed around the ear to prevent its being pressed flat against the skull Care must be taken when the gauze is applied over the ear to see that the ear is not folded or twisted This sometimes happens, particularly at the lower part of the ear, and may occur when the bandage is applied The bandage should be applied in such a manner that it will not slip up and off, or down and cover the patient's eyes

The patient can be made very uncomfortable by a poorly applied bandage, particularly one that slips down over the eyes The bandage can be expected to stay in the proper position if the first three turns of the bandage are applied to cover just the upper part of the dressing, passing just above the opposite ear and across the forehead so that half of the bandage is below and half above the normal hair line The next turn of the bandage covers the lower margin of the dressing, and the remainder in between is covered by subsequent turns of the bandage If the bandage is too loose it will slip up or down, if it is too tight it will cause headaches and may cause edema of the face on the operated side

The bandage and dressing are left untouched for seven days On the seventh day, using sterile technique, the bandage is removed The area around the ear is painted with tincture of Zephiran and all packing removed, great care being used to prevent movement of the skin graft Usually very little if any bleeding occurs. The meatus is again painted with Whitehead's varnish and a piece of paraffin mesh the same size as the meatus is reinserted This is impregnated with neomycin ointment. The head dressing is again applied and left in position for four more days The patient is instructed not to blow his nose for a period of three to four months as pressure through the Eustachian tube could disturb the graft covering the middle ear[16]

On the 11th post-operative day the bandage is removed, and the ear and cavity inspected No attempt is made to enter the cavity or remove any clot or fibrin that may have formed If fluid has formed under the graft in the middle ear it should be removed by a paracentesis of the graft. Another piece of mesh the same size as used previously is reinserted It is to be noted that no attempt is made to split open the incision as this is not necessary and is definitely contra indicated.

On the 14th day the bandage is removed and left off The cavity is again inspected but no instruments are placed inside the meatal opening Any fluid in the cavity is allowed to run out into a sterile piece of gauze The meatal opening is painted with Whitehead's varnish and the mesh, with neomycin ointment is inserted A small piece of sterile absorbent is placed in the concha, and the patient is instructed to replace this cotton approximately three times daily, or oftener if it becomes saturated

After the 22nd day the patient is seen once a week for a period of three weeks The mesh may be left out entirely after the 22nd day, but if the cavity is dry it may be left in for five or six weeks which keeps the cavity clean, however if there is a moderate amount of discharge the cavity can be cleared up more rapidly by leaving it open to the air

The patient is instructed to keep the ear and the area around the ear clean by using peroxide to soften and remove the discharge and to dry the area with 70 per cent alcohol If the discharge is copious after the first dressing is done it is sometimes necessary to change the dressing oftener and instil some type of antibiotic powder In our experience best results have been obtained by using terramycin powder, however, chloromycetin, penicillin, aureomycin and neomycin powders have been used Best results are obtained using the antibiotic in powder form

In the majority of cases at the end of six weeks the cavity is epithelialized and dry In some cases, however, it is necessary to remove granulation tissue and cauterize the raw areas with 20 per cent silver nitrate and paint them with a 25 per cent aqueous gentian violet solution All mastoid cavities should be inspected approximately every four or six months to remove epithelial debris, cerumen and crusts Following removal of this material the cavity should be dusted with boric and iodine powder The cavities can be kept clean by syringing with an acetic acid and alcohol solution every two or three weeks as suggested by Farrior[16]

THE MODIFIED RADICAL MASTOIDECTOMY

After the tympanomeatal flap has been created and packed forward with three pieces of paraffinized silk, the mastoid cavity is completely exenterated and the posterior canal wall is thinned, lowered and removed Under magnification a careful examination is made of the antral area A decision must be made as to whether the incus and head of the malleus should be removed All the granulation tissue in the area is carefully taken out and the bleeding controlled All visible cholesteatoma matrix is removed Much has been written for and against the removal of the cholesteatoma matrix (Baron[17, 20b] Juers,[18] Moore,[19] Walsh,[20a] Williams[10]) It is impossible to know what disease or extension of the cholesteatomas is present if all visible matrix is not removed

It is usually necessary to remove the incus and head of the malleus to allow inspection of all the regions On numerous occasions after all visible matrix has been removed, when head of the malleus is amputated, cholesteatoma can be found anterior to the malleus which was otherwise hidden Removal of the head of the malleus also allows better inspection of the middle ear and makes it possible to seal off the epitympanic space completely at the completion of the operation There are otologists[11 19 20b,22 23] who feel the disease should be dissected way from around the ossicles Even if this was an easy procedure, which it is not, there is likely to be disease lurking behind the ossicles which cannot be seen until they are removed

As stated by Day,[7] the operation must be made to fit the individual case. Whether or not the incus and head of the malleus are removed will depend primarily on the pathology present and its removal There must be no compromise with pathology Of secondary importance is the function of the ossicular chain. If it is intact and functioning, then extra efforts should be made to preserve its continuity If it is fixed or partially destroyed, then the incus and head of the malleus must be removed to eradicate the pathology, and in some instances the hearing will be improved by mobilizing a fixed stapes

Great care must be exercised in the removal of the cholesteatoma matrix as there may be a fistula into the horizontal canal or complete erosion of a canal The facial nerve may be exposed and will be particularly vulnerable if the horizontal canal has been eroded In removing the cholesteatoma matrix from the dura or sigmoid sinus great caution must be exercised or a dural leak or sinus hemorrhage may result[24]

In 1 500 cases I have had four dural tears with spinal fluid leak and one sigmoid sinus tear with hemorrhage. All have occurred in cases where pathological exposures were present and where an attempt was being made to remove the cholesteatoma matrix I have exposed the dura and sinus on numerous occasions in fenestration surgery and have removed granulations from the dura in pathological exposures, where there was no cholesteatoma present, without tears or perforations It is my opinion that the cholesteatoma matrix causes a thinning or atrophy of the exposed dura in such cases

The tympanomeatal flap must be elevated anteriorly as far as is necessary to visualize all the areas where disease may be present In certain cases it is necessary to dislocate the tympanic membrane partially from its sulcus postero-inferiorly if disease is discovered in the region of the round window Juers[25] advocates this procedure in certain cases to produce contact between the stapes and the pars tensa to improve the hearing when the incus is absent

To obliterate perforations that are encountered in the attic region of the tympanic membrane it is sometimes necessary to split the tympanomeatal flap down through the perforation, trim the margins of the perforation and then pack them together Occasionally when a large perforation is present in the attic region, the blood supply may not be sufficient to nourish the remainder of the flap If such is the case the outer portion of the flap should be cut off, thinned and placed in the mastoid cavity as a separate graft This prevents a slough of the flap and also gives the flap that remains a much better chance of surviving

In a certain number of modified radical mastoidectomies the tympanomeatal flap is not large enough to cover adequately the mastoid cavity In such instances a separate skin graft should be obtained either from the post-auricular area or from a hair-free area on the thigh and placed in apposition to the tympanomeatal flap This produces more rapid healing due to the absence of raw areas which frequently produce granulations if left uncovered

In an attempt to obtain a dry middle ear and maintain good hearing in a patient with a large central perforation, a skin graft over the perforation, using the method described by House[26] may be employed I have used this method on six cases In two cases the skin grafts have taken and the perforations have closed In the four other cases the graft sloughed out very shortly after the packing was removed, and the perforations remained This procedure requires further investigation

The modified radical mastoid operation is completed by fashioning a meatal opening similar to that described for the radical mastoidectomy The post-operative care is essentially the same except that if a tympanic perforation persists, efforts should be made to obtain healing

THE FENESTRATION OPERATION

The same incision and meatal flap is employed for the fenestration operation In general, the creation of the flap is more easily carried out in the fenestration operation as there is usually less bleeding, a better developed bone, and no infection to deal with, however, since the result of the operation depends so much on a perfect tympanomeatal flap there is no margin for error A small persistent perforation in the tympanic membrane can easily make the difference between success and failure A tympanomeatal flap which does not survive due either to trauma or poor blood supply, will result not only in lack of improvement in hearing, but may also result in further deterioration with the possibility of a labyrinthitis

If there is reasonable doubt that a tear in the tympanic membrane will not heal quickly, or that there is not sufficient blood supply to the flap required to cover the fistula, then the fenestra should not be made until the perforation has been allowed to heal and the mastoid cavity has been completely epithelialized If the meatal flap is longer than necessary to cover the fenestra the outer portion should be cut off to insure good blood supply to the remaining portion The excised portion can then be thinned and used as a separate skin graft in the fenestration cavity

Before making the fenestra the flap must be carefully examined for bone dust or chips This is done by using magnification and a cotton applicator dipped in adrenalin to sweep the flap free of such particles Where bone particles are adherent to the flap they should be removed with sharp scissors using either a fine suction tip or fine forceps to hold the fragment

One of the commonest sources of bleeding during the making of the fenestra, is from the incision made along the anterior canal wall in the formation of the antero-superior portion of the flap This bleeding can be readily controlled if the incision area is covered with a small piece of gelfoam During the making of the fenestra, the meatal flap should be kept moist either by flooding the cavity intermittently or by placing a thin piece of moist absorbent cotton over the flap A considerable amount of heat is produced from the bright light required for illumination and I think it is important that this tissue be protected from the heat, so damage to the flap will not result

When the fenestra has been made, the meatal flap should again be inspected for bony particles and then floated into position A fine suction tip should be available to aspirate any blood that may have collected in front of the meatal flap and to prevent blood in the external canal from entering the fenestration cavity before the fenestra has been properly sealed off

Lindsay[27] and Lempert[28] have stated that it is necessary for the meatal flap to become adherent to the membranous duct in order to maintain a patent fistula Various methods have been described I use a piece of folded paraffinated silk to cause pressure on the flap over the fenestra This is then held in position with paraffin mesh If the paraffin mesh alone is used, an open space in the mesh, over the fenestra, would prevent proper adaptation of the flap to the duct The use of magnification is very important when applying the packing to the flap It allows for more gentle handling of the packing, more accurate positioning without shifting of the flap and possible shearing of the membranous duct.

In a small fenestration cavity the tympanomeatal flap is usually large enough to cover the exposed bone area, and insure rapid healing, however, in the large pneumatic type of temporal bone it is quite often impossible to limit the size of the fenestration cavity, and in these cases it is necessary to introduce a thin skin graft taken either from the thigh or abdomen This graft should be fitted in accurately so that all the raw areas of bone are covered Needless to say the donor area should be carefully prepared to prevent the possibility of introducing an infection into a sterile cavity After the meatal flap and skin graft, if used, have been properly placed and held in position, the final closure of the cavity is accomplished in the same manner as described for the radical mastoidectomy

Using sterile technique the first dressing is done on the seventh post-operative day when the outer packs are removed and the last mesh pack over the fenestra loosened A piece of paraffin mesh is placed in the meatal opening and the bandage reapplied On the tenth post-operative day the last piece of mesh and the silk are removed This must be done with good illumination so the position of the meatal flap will not be disturbed The mesh is again inserted in the meatal opening and the bandage reapplied On the 14th postoperative day the bandage is removed and left off

The fenestration cavity is inspected at weekly intervals following the 14th day, but no instruments are introduced into the cavity unless absolutely necessary This may be necessitated by the presence of granulations which have to be removed Blood and fibrin clots are allowed to remain The meatal opening is kept closed with paraffin mesh for approximately four weeks following operation The patient is instructed to place a piece of absorbent cotton, lubricated with neomycin ointment, just external to this mesh to absorb any secretion which drains from the fenestration cavity This cotton is changed as often as is necessary A definite routine should be established in the care of these cavities if uniform good results are to be obtained

The two commonest soft tisue complications seen in fenestration surgery are granulation tissue forming behind the conchal margin, and narrowing of the meatal opening Both of these complications can be reduced to a minimum by proper surgical treatment of the soft tissue structures at the time of operation, so that no raw areas are left exposed The most important factors are the suturing of the skin margins to the periosteum and the temporal muscle and applying skin grafts where necessary to cover raw bone and soft tissue surfaces

A rare post-operative complication is infection This is prevented by the use of antibiotics prophylactically, and adherence to strict sterile technique, both at the time of operation and at post-operative dressings Should infection occur a culture should be taken to identify the causative bacteria and its sensitivity determined Proper antibiotics used locally in powdered form will practically always control the infection without difficulty The presence of a persistent discharge and granulations in the lower part of the fenestration cavity usually indicates involvement of the tip cells which were not removed at the operation If conservative local treatment is not sufficient, it is necessary to revise the area and remove all infected cells, then apply a secondary skin graft These cavities usually heal very rapidly following this procedure

TREATMENT OF SOFT TISSUE COMPLICATIONS

STENOSIS OF MEATAL OPENING

Stenosis of the meatal opening may occur in temporal bone surgery whether an endaural or postauricular incision is made The best treatment of this complication is prevention, which can be accomplished by the methods mentioned previously, namely, creating a proper meatal opening and maintaining it by covering all the raw areas either by meatal skin or skin grafts to prevent scarring and retraction

In addition to the stenosis caused by concentric scarring, a moderate number of narrow openings are seen which have resulted from a downward displacement of the ear as a result of cutting the supporting ligaments and muscles This allows the membranous meatal opening to fall downward while the bony external canal remains in its normal position This results in a narrow membranous canal which extends upward and backward at an acute angle This has been seen more frequently in recent years when unsuccessful postauricular mastoidectomies have been revised by the endaural route, with the result that practically all the normal supporting structures of the ear are incised and the ear falls downward and backward into the mastoid cavity, assisted by scarring and retraction

To repair a stenosed meatus it is, therefore, necessary not only to create a proper meatal opening but also the ear must be properly positioned and fixed so that it will not be displaced downwards by scarring The endaural incision is reopened and the scar tissue removed The periosteum is elevated beginning superiorly under the remains of the temporal muscle It is very difficult to begin the elevation of periosteum posteriorly due to the presence of the mastoid cavity Once the bony plate of the skull has been identified under the temporal muscle the periosteum can be elevated backwards and downwards, and the ear mobilized

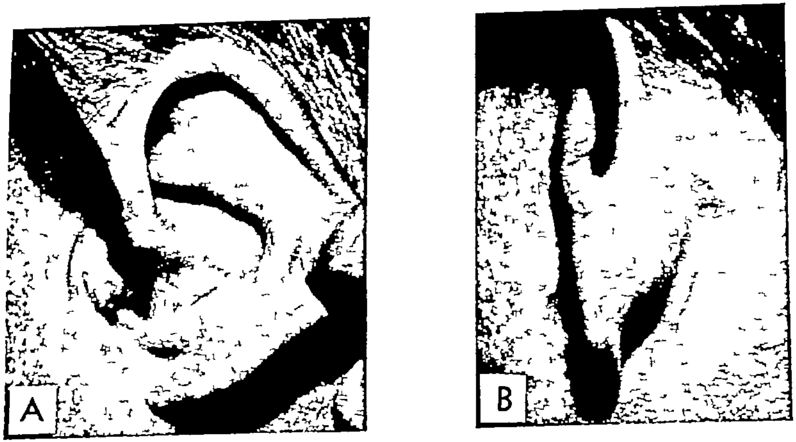

Fig 4A and Fig 4B Appearance of an ear following one postauricular mastoidectomy with marked narrowing of the external canal due to displacement of the ear downwards and backwards into the mastoid cavity caused by lack of support and scarring

Great caution is necessary in this procedure if there are any dural or sinus exposures, or if there is a thin atrophic post-auricular scar which is firmly attached to the bone After the ear has been mobilized and the endaural retractor placed in position the mastoid cavity and middle ear are revised as required and skin grafts are placed over the exposed bone and held in position with paraffin mesh packs

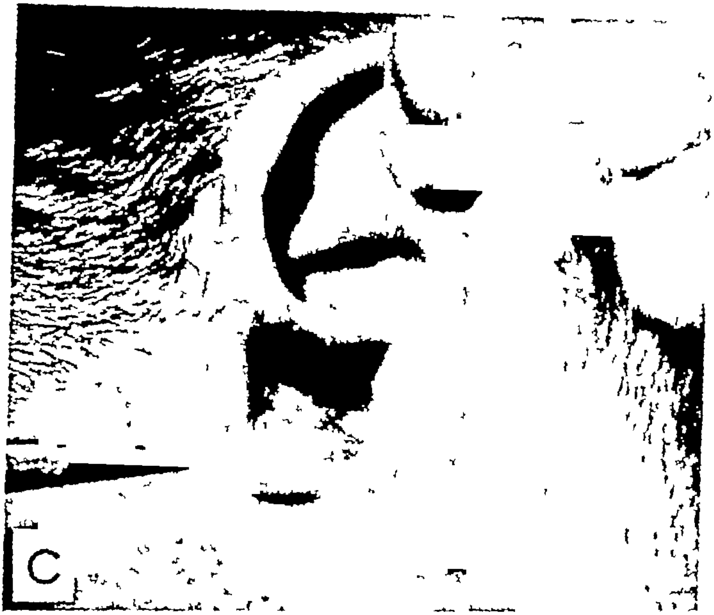

Fig 4C Appearance of the same ear following a revision by the endaural technique combined with suspension of the ear and a skin graft in the upper part of the endaural incision

A second incision is made postero-superiorly to the ear down to the fascia of the temporal muscle An elevator is passed downward and forward along the fascia to the endaural incision above the incisura The ear is suspended and the endaural incision held open by suturing the posterior margin of the endaural incision to the temporal fascia, just posterior to the counter incision Usually four No 000 plain sutures are sufficient to accomplish the required fixation The raw areas produced by the stripping of the temporal fascia heal together and fix the ear in its proper position as well as holding the endaural incision well open A thin skin graft is placed in the upper part of the endaural incision and held in position

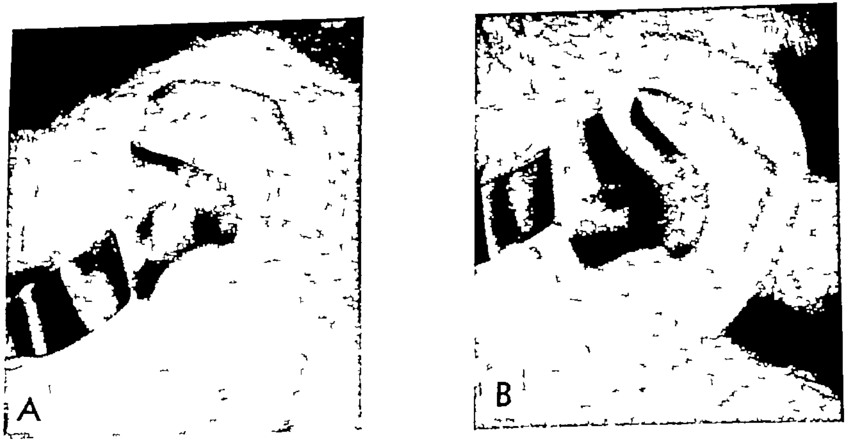

Fig 5A Appearance of an ear with congenital atresia of the external auditory meatus The external meatus is represented by a shallow dimple.

Fig 5B. Appearance of the same ear following an operation for reconstruction of the external meatus and the middle ear The endaural technique was used with a thin skin graft in the upper part of the incision combined with a posterosuperior counter incision to suspend the ear and to keep the endaural incision open

with mesh packing, or it may be sutured with No 00000 Dermalon

This procedure can be modified by turning a flap of skin down from the post-auricular area into the endaural incision This procedure has been used in revisions of mastoidectomies and in eight cases of congenital atresia It has produced excellent meatal openings without the necessity of using any type of prosthesis to maintain the openings during the healing period Prior to using this method attempts were made to maintain an adequate meatal opening after operation by using either acrylic, tantalum, or polyethylene prostheses In most cases granulation tissue formed beneath and internal to these appliances and in addition caused considerable discomfort to the patient The end results using prostheses were inferior to those obtained by the method just described

Stenosis of the meatus may also occur as a result of keloid formation along the line of the endaural incision This presents a very difficult problem in treatment Revision of the incision with removal of the keloid and skin grafting is the method of choice

PERICHONDRITIS

A relatively uncommon complication of temporal bone surgery is an infection of the perichondrium Perichondritis can develop following either a post-auricular or an endaural incision During the past year I have treated three cases of perichondritis, two have followed post-auricular surgery and the other endaural surgery The development of a perichondritis should be watched for diligently, as the final distortion of a neglected perichondritis is disastrous Early recognition is of utmost importance Before there is gross evidence of a perichondritis the patient will complain of tenderness and stiffness of the ear

If the ear is carefully examined at this time there can usually be found a slight, diffuse enlargement of the ear when it is compared to the opposite side Tenderness on movement of the ear is present which is out of proportion to the appearance of the ear The entire ear is warmer than normal and has a definite bluish-pink blush As a rule, no localized cellu litis or abscess is evident in the early stages, but if it is allowed to go untreated, a localized area of suppuration will become evident. Infection of the perichondrium is rarely seen until a period of 10 to 14 days or longer has elapsed after surgery

If the incision is completely extra-cartilaginous there is little danger of a perichondritis developing, however, the necessity for a large meatal opening occasionally requires extension of the incision into the cartilage If the cartilage is covered by viable tissue at the completion of the operation and suitable antibiotic therapy is used, perichondritis is not to be feared

At the earliest suggestion of a developing perichondritis hot fomentations should be used continuously These can be alternated with dry heat supplied by a shaded electric light bulb placed close to the ear Once there is evidence of localization an incision is made down through the perichondrium and any dead cartilage removed The incision should be carried through to the posterior aspect of the ear, then through and through packing employed[20] The infecting agent is usually B pyocyaneus so the packing is impregnated with neomycin ointment. Fresh packing should be reinserted every other day, until all evidence of the infection has disappeared This method of treatment has resulted in rapid resolution of the infection with excellent cosmetic results Conservative therapy with inadequate drainage results in prolonged morbidity and frequently with a marked deformity of the ear

FACIAL PARALYSIS

No other structure causes more concern to the temporal bone surgeon than the facial nerve The fear of damage to the facial nerve in the surgical field has resulted in many inadequate surgical procedures With the advent of modern temporal bone surgery and a better knowledge of the detailed anatomy, using good illumination and magnification, there is less chance of damage to the facial nerve however it is important for the surgeon to be able to recognize any accidental injury that has occurred and to be able to carry out the proper procedures to prevent permanent damage This may entail the removal of a depressed bone chip, partial decompression of the nerve, end to end approximation of the severed nerve, or a nerve graft[30] The proper time to repair these injuries is when they occur and not several days or months following the damage

If the facial paralysis is evident when the patient regains consciousness the operative site should be revised the following day and the necessary repairs done If the facial paralysis becomes evident at a later stage it is likely due to increased pressure on the nerve resulting from the packing or due to edema of the nerve itself Relieving the pressure by loosening or removing the packing will often be sufficient to restore the function of the nerve

SUMMARY

1 The success of temporal bone surgery frequently depends on the management of the soft tissue structures This consists largely of adhering to strict sterile technique, maintaining a dry well-illuminated field and treating all the tissues involved with gentle, meticulous care

2 In the simple mastoidectomy the post-auricular incision is the incision of choice It has been my experience that these cases can be completely closed, which results in primary healing of the post-auricular incision and rapid healing of the tympanic perforations, providing the proper antibiotic is employed using an adequate dosage

3 In temporal bone surgery for chronic otitis media and for otosclerosis, the endaural incision is the incision of choice

4 Residents who have gone from our training course have experienced the most difficulty from stenosis of the meatus, and the formation of granulation tissue under the conchal margin The primary endaural incision is of extreme importance in preventing the granulations and stenosis The careful selection of a line of incision 6 mm deep to the conchal margin makes it possible to suture the meatal skin to the periosteum, and completely eliminate any exposed cartilage also to eradicate a probable area for the formation of granulation tissue under the conchal margin

5 The elimination of all raw surfaces of bone and soft tissue, by the use of a well thinned meatal skin used either as a tympanomeatal flap or as a free skin graft along with thin skin grafts from other parts of the body, prevents scarring and stenosis of the meatal opening and the formation of granulation tissue

6 The question of removing the cholesteatoma matrix has been carefully considered, and it is felt that it should be removed as completely as possible It is pointed out that there is definitely a thinning and atrophy of exposed dura, if not actual invasion by the cholesteatoma matrix, and there is a real danger, in its removal, of a spinal fluid leak or a sinus hemorrhage.

7 It has been my experience in six modified radical mastoidectomy operations, where a skin graft was placed over the tympanic perforation, that only two resulted in a closure of the perforation It is questionable whether this is a larger percentage than could be obtained by using the older methods for closure of tympanic perforations

8 Two points have been made in the fenestration operation one is the protection of the tympanomeatal flap from the heat produced by the source of illumination The second is the attempt to approximate the meatal flap to the membranous duct which has been helped by the use of a paraffinated silk pack directly over the fenestra Paraffin mesh alone does not accomplish this

9 The constant attention paid to the removal of all bone chips from the depths of the mastoid cavity and under the skin margin is a simple but important part of all procedures

10 The two complications of the stenosis of the meatal opening and the displacement downward of the whole auricle have been discussed A surgical method of plastic repair has been described for these troublesome post-operative results In our hands this method has offered the best hope of a satisfactory result.

CONCLUSIONS

The technique of the treatment evolved from the observation of many temporal bone surgeons, cadaver surgery, and the experience of 1,500 cases has been discussed New methods and ideas do not come in great numbers at any time, and only a few are presented The surgical treatment of the temporal bone itself has been discussed adequately many times, but this has been an attempt to consider the importance of the adjacent soft tissue structures

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174 St. George Street

THE ATYPICAL EFFECT OF A HEARING AID ON ONE PATIENT WITH CONGENITAL DEAFNESS

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It has been speculated by many clinicians that the high intensity acoustic signal which is presented to the ear by means of a hearing aid may, particularly in cases of perceptive deafness, have a traumatizing effect on the residual hearing and, as a result, may be damaging to the ear In reference to this speculation, a case is being presented which appears to contribute additional insight to this apparent phenomenon of which there is, at present, only meager information

R A L, an eight year-old female with bilateral congenital perceptive deafness of the familial type, first started wearing a hearing aid at the age of five years at that time the audiogram indicated a bilateral loss of equal degree (see Fig 1 a)

Three years later, one of the authors (E R H) conducted audiometric studies on the child and discovered a significant difference between the two ears (see Fig 1 b) It is noted that the nonstimulated ear had remained essentially the same throughout the three year period whereas the stimulated ear produced evidence of progressive deafness At this time, it was recommended that the hearing aid be removed from the left ear and placed on the right.

Following two and a half months of wearing the hearing aid in the right ear the mother complained that the child's hearing appeared to be getting worse and as a result supplementary audiometric studies were conducted It was discovered that the left ear had recovered to its pre-stimulation threshold whereas the right ear produced evidence of progressive deafness[1] (see Fig 1 c) At this time the hearing aid was removed from the right ear placed on the left and after one week another audiometric assessment was conducted (see Fig 1 d) It is

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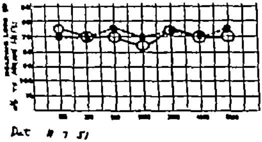
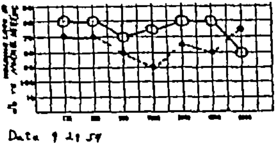
noted that the right ear produced evidence of partial recovery whereas the left ear indicated a progressive loss. At this time the hearing aid was removed for a period of one week and following that time another audiogram was obtained (see Fig. 1 e) It is now noted that, following this period without amplification both ears restabilized themselves to essentially the same level of three years previous!

Since the noted threshold shifts lie essentially within the frequency range of stimulation (800-3500 cps), and since the prolonged temporary threshold shift is produced by high intensity acoustic stimuli, it is apparent that this case produces characteristics which are similar to both adaptation and auditory fatigue Although its significance is not com

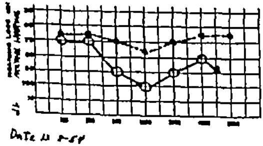


Before hearing aid was recommended

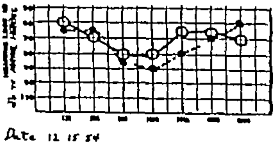


b

After wearing hearing aid in left ear for three years Hearing aid changed from left to right ear

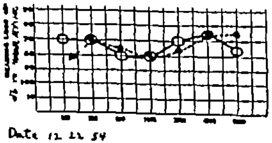


Two and one half months after changing hearing aid from left to right ear hearing aid changed to left ear



d

One week after changing hearing aid back to left ear (Hearing aid removed)



e

After one week of not wearing a hearing aid in either ear

Fig 1

pletely understood, this case supplies us with evidence that such a condition exists and, as such, suggests that more carefully planned studies should be carried out in regard to the effects of amplification on residual hearing It should be pointed out, however, that this is an atypical example of hearing dysfunction and, until such time that supportive research has been carried out, the reader is cautioned against interpreting this report as evidence supporting the concept *that hearing aids may cause damage to the ear*

RUPTURE OF THE BRONCHUS

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Bronchial rupture caused by a closed chest injury is uncommon, and is usually diagnosed at autopsy or many months or years after the initial injury Recently there have been reports of bronchial rupture which has been diagnosed within a few days to weeks after the injury and treated by pneumonectomy plastic repair or re-anastomosis This is a report on another case, demonstrated bronchoscopically and treated by bronchial resection with end to-end anastomosis, in which the patient made a complete recovery

REVIEW OF LITERATURE

In 1947 Kinsella and Johnsrud[1] reviewed the literature and added two cases of their own, bringing the total to at least 38 patients, 19 of whom recovered They noted that traumatic bronchial rupture was rare and that it was recognized, clinically, with even greater infrequency Most patients gave a history of a severe compression or crushing injury with or without rib fracture Hemoptysis, profound shock, tension pneumothorax, hemothorax, or subcutaneous emphysema often followed

The right and left main stem bronchi were involved with about equal frequency, usually within one to three centimeters of the trachea, without involvement of the major hilar vessels, or the lung The majority of the patients received no definitive treatment. As a result, stenosis of the bronchus or complete occlusion with atelectasis occurred

In 1948 Holinger Zoss, and Johnston[2] reported three cases in which recovery occurred two were diagnosed broncho-

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scopically and one by bronchogram Bronchoscopic treatment was attempted in one case, but without success One patient received no definitive treatment, the other two had pneumonectomy Both resected lungs (at four months and at three years after injury) showed only chronic atelectasis without evidence of infection

Paulson[3] in 1951, reported eight more cases in which the patients recovered, and added two of his own He also noted in one of his patients, treated 10 years after injury by pneumonectomy, the absence of infection in atelectatic lung distal to a complete bronchial occlusion Two other cases of bronchial repair at thoracotomy have been reported[4, 5]

MECHANISM

Bronchial laceration from penetrating chest injuries is easy to understand, and the result is usually fatal Bronchial rupture from closed chest injuries is a different problem the mechanism may be one of sudden increase in intrathoracic pressure against a closed glottis This produces either a shearing force at the hilum and a tearing of the least flexible structure, the bronchus, or a sudden increase in intrabronchial pressure with actual rupture of the bronchus Tension pneumothorax, hemothorax, mediastinal and subcutaneous emphysema, and/or hemoptysis may ensue

If the tear in the bronchus is not complete, the patient may experience only hemoptysis, atelectasis may develop if a blood clot forms in the bronchus If obstruction of the bronchus is complete and the organ was normal prior to the atelectasis, infection does not supervene in the atelectatic lung

DIAGNOSIS

The most important factor in the diagnosis of bronchial rupture is the awareness of this possibility in any chest injury The symptoms may be no different from those of a chest injury without bronchial rupture Mediastinal emphysema, without pneumothorax, should arouse suspicion of bronchial (or esophageal) rupture

Bronchial rupture should be suspected with tension pneumothorax or hemoptysis in a nonpenetrating chest injury without rib fracture Persistent, recurring, or delayed atelectasis following a chest injury is quite characteristic of bronchial rupture

Once the suspicion has arisen, the diagnosis can be made by bronchogram, bronchoscopy, or thoracotomy Bronchography in an acute case is unwise, and the information obtained may be equivocal Atraumatic bronchoscopy, following meticulous local anesthesia, will give much more definite information, particularly since rupture, as reported, occurs only in the main stem

Thoracotomy as a purely diagnostic measure is not indicated in chest trauma, however, with uncontrolled or persistent tension pneumothorax or intrapleural bleeding, thoracotomy may lead to operative diagnosis of bronchial rupture, as was true in Scannell's case.[5]

TREATMENT

Most survivors of this injury have received no definitive treatment, the condition being diagnosed in retrospect when stenosis of the bronchus or total atelectasis has been found at autopsy or on routine physical examination years after the injury

Pneumothorax, oleothorax, or thoracoplasty have been suggested for symptomatic relief in patients with total atelectasis Bronchoscopic treatment has been carried out,[2, 1, 6, 7] but this has been tedious and unsuccessful except where a thin diaphragm existed which could be incised and would require no further treatment.

Pneumonectomy has been the treatment in four cases[1 2 3] diagnosed four months to ten years after the injury because of symptoms of chronic atelectasis These lungs showed only uncomplicated chronic atelectasis, suggesting that re-expansion might have been possible if a repair of the bronchus had been attempted

Repair of bronchial stenosis after rupture of the bronchus has been reported Paulson[8] reports a case of chest injury in which a bronchial stenosis developed Re-expansion of the lung followed plastic repair of the bronchus with a dermal graft Griffith[10] did a resection of the bronchus with end-to-end anastomosis seven months after a chest injury in which stricture with obstructive emphysema had occurred

Weisel and Jake[4] reported a case of bronchial rupture in which complete obstruction of the bronchus developed within 20 days of the chest injury Forty-six days after the injury, thoracotomy revealed a 6 5 cm separation of the divided ends The distal end was opened, the lung was aspirated and inflated, and the anastomosis was done to a window in the trachea, using an endotracheal tube as a stent Two months later the bronchogram was normal

The ideal treatment of bronchial rupture is immediate thoracotomy, if feasible, and repair of the injured area Scannell[5] did a thoracotomy for tension pneumothorax three hours after a chest injury He found and repaired a laceration of the bronchus Two other cases of sutured bronchial lacerations are reported[8,9]

The results from repair, or resection and end-to-end anastomosis, bear out the experimental work of Kiriluk and Merendino,[11] who transected and re-anastomosed a main stem bronchus in 59 animals, and found no evidence of stenosis The plane of transection and suture material used (gut, silk, cotton) did not affect healing They demonstrated that interrupted through and through sutures were best, and that the suture lines had adequate strength (to pressure) at three days, and were completely stable by 14 to 21 days

CASE REPORT

A 24 year-old man was admitted to Letterman Army Hospital on January 8, 1954 after having been involved in an automobile accident four days earlier He was initially cared for at a civilian hospital where he presented a right pneumothorax fracture of the second and third ribs in the midaxillary line, and extensive subcutaneous emphysema. A tracheotomy was done and catheter drainage of the chest instituted There was no previous history of chest trouble

On admission to Letterman Army Hospital his temperature was 101°, respirations were 28, and his pulse was 112 A tracheotomy tube was in place, and there was massive subcutaneous emphysema The chest tube had been removed prior to admission There was marked splinting of the right hemithorax and breath sounds were absent in lower two-third with hyperresonance above The mediastinum was shifted to the left

Laboratory examination revealed a mild leukocytosis and no evidence of anemia The initial X ray examination showed fractures of the right second and third ribs in the midaxillary line a collapse of the right lung with a fluid level extending to the fifth rib posteriorly and subcutaneous emphysema

On admission the patient represented a simple problem of a crushed chest with hydropneumothorax on the right and massive subcutaneous emphysema due to fractured ribs on the right. On the day following admission 100 cc. of bloody fluid was obtained by thoracentesis No organisms could be cultured On the following day another 100 cc of serosanguineous fluid was aspirated By January 14 1954 the chest X ray was beginning to demonstrate further resolution of the fluid within the right side of the chest without further aspiration Four days later the subcutaneous emphysema had almost subsided and the tracheotomy was occluded After 48 hours the tracheotomy tube was removed and the patient appeared to be well on the road to recovery He was ambulatory about the ward and complained only of some pain in the right side of his chest.

On January 29 1954 the patient complained of anterior and posterior midline chest pain He was afebrile and there was no alteration of his pulse rate however chest films revealed massive atelectasis on the right side (see Fig. 1) Breath sounds were absent in the right side of the chest and only bronchial breathing was heard The mediastinum was sharply shifted to the right. Tracheal suction was begun and the patient was placed on antibiotics He was coughing satisfactorily but the cough was nonproductive On January 31 when no progress could be made in relieving the obstruction, bronchoscopy was requested.

Using local anesthesia an 8 mm. 40 cm bronchoscope was introduced revealing a complete block ¾ cm below the coryna in the right main stem bronchus This appeared to be inspissated bloody mucus and could not be removed with suction but irrigation with saline solution resulted in easy removal of the material. There was no bleeding following this and the bronchoscope was passed further into the bronchus revealing normal upper middle and lower lobe bronchi

Following bronchoscopy there was a return of the hemothorax and 50 to 75 per cent re-expansion of the lung. Thoracentesis on February 1 yielded 150 cc. of serosanguineous material The patient was ambulatory and by February 7 he had very little dyspnea or chest pain. Later in the day there was a sudden return of all symptoms despite an adequate cough, and X ray demonstrated a total collapse of the right lung Tracheal aspirations were again begun, but to no avail, and on the next day (eight days after the first bronchoscopy) bronchoscopy was again accomplished.

The trachea was markedly deviated to the right and a complete block was encountered ¾ cm. below the coryna on the right, where there was a firm gray mass A biopsy was taken and the forceps were then insinuated through the mass. This resulted in strong coughing and an immediate shift of the trachea to the midline Tissue examination demonstrated well developed squamous epithelium on a fibrous stroma that was highly vascular

The pathogenesis of the stenosis was not recognized and two days later bronchoscopic dilatation of the area was carried out to a 7 mm diameter

The atelectasis cleared markedly following the dilatation but a review of the records showed that the stenosis was probably the result of a bronchial rupture and thoractomy was planned in case atelectasis should recur Eleven days following the dilatation atelectasis did recur and bronchoscopy was repeated to give symptomatic relief prior to definitive surgery The results were minimal

On February 25, 1954, 52 days following the initial injury, thoracotomy was carried out with left endobronchial anesthesia* The lung was atelectatic and anteroinferiorly adherent to the chest wall There had been a complete bronchial rupture with the proximal stump displaced posteriorly A 2½ cm section of bronchus including the stenotic area was removed and the purulent material found in the distal bronchi was aspirated The proximal and distal stumps were anastomosed using interrupted 000 silk through the entire bronchial wall The chest was drained and the patient tolerated the procedure well The postoperative

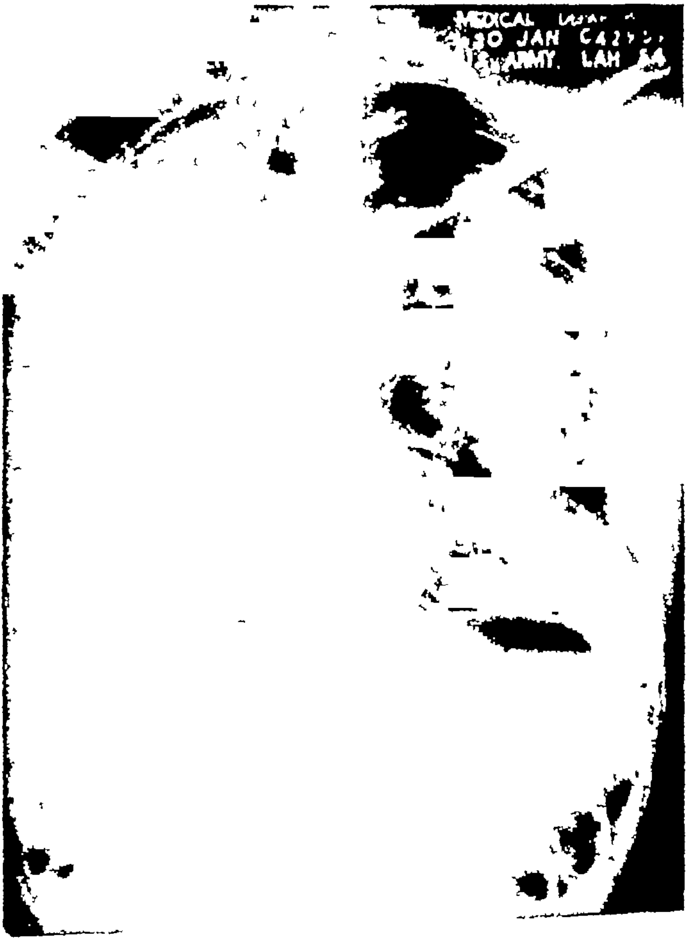

Fig 1 X ray prior to first bronchoscopy

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* Surgical repair by Dr Roy Cohn civilian consultant Surgery Letterman Army Hospital San Francisco California

course was uneventful except for the development of post thoracotomy chest pain, which disappeared by April 12 1954 when the patient was discharged to duty X ray revealed re-expansion

On June 9 1954 the patient was re-admitted to the hospital for X ray and bronchoscopy At that time he had no dyspnea, some chest and right arm pain with weight lifting and 80 per cent of normal vital capacity Physical examination was negative except for healed surgical incisions. X ray revealed complete aeration of the lung fields with some haziness due to pleural thickening (see Fig 2)

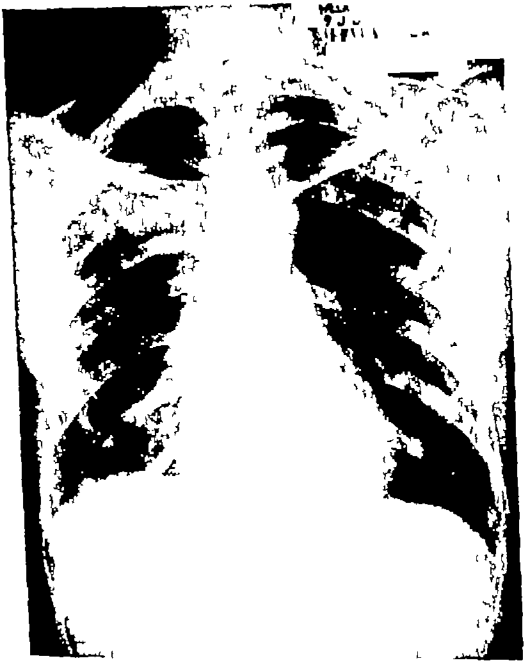

Fig X ray 3½ months postoperatively showing re-expansion with some haziness due to pleural thickening

Laminogram showed 90 to 95 per cent of the normal lumen Bronchoscopy was accomplished with an 8 mm. 40 cm Jackson bronchoscope which passed through the main stem bronchus easily There was no evidence of stenosis The suture line could be seen as a fine white scar with an occasional black suture showing

COMMENTS

Apparently the blood in the pleural cavity came from the area of rupture, since bleeding immediately recurred following the first bronchoscopy It is also apparent that the "fractured bronchus" was splinted by the intraluminal blood clot at the time of the first bronchoscopy, and that removal of this clot resulted not only in bleeding into the pleural cavity but displacement of the "fracture" as well

This displacement, obvious at thoracotomy, explains the development of complete occlusion by tissue eight days later Perhaps it would have been advisable, had the diagnosis been suspected, to have left the blood clot alone, however, it seems likely that stenosis, or complete occlusion, would have developed regardless, and it would have been difficult to have established the diagnosis without its removal

The diagnosis of bronchial rupture should have been made at the time of the second bronchoscopy, and attempts at dilatation should not have been made There is a much greater chance of infection below the block if the block is incomplete Although no trouble was encountered postoperatively, a lung free of infection would have been assured if dilatation had not been attempted

SUMMARY

The literature on bronchial rupture from closed chest injury, including mechanism, diagnosis, and treatment, has been briefly reviewed A case of rupture of the right main stem bronchus, demonstrated bronchoscopically and repaired by resection and end-to-end anastomosis 52 days after injury, is reported There was completely recovery without stenosis of the bronchus

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TRANSACTIONS
OF THE
AMERICAN LARYNGOLOGICAL ASSOCIATION
(Scientific Sessions)*
SEVENTY-SIXTH ANNUAL MEETING
MARCH 13-14, 1955
HOLLYWOOD BEACH, FLORIDA
DR HENRY B ORTON, President

*Abstracted by SAMUEL SALINGER, M D , Palm Springs, California

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THE INDICATIONS AND TECHNIQUE OF LYMPH NODE DISSECTION OF THE NECK

ALTON OCHSNER, M D

Metastasis to the regional lymph nodes is very common with malignant lesions about the oral cavity because of the rich lymphatic drainage Most of these remain localized in the cervical nodes for a long time except in the case of transitional cell carcinomas and lympho-epithelioma which may metastasize widely very early

The decision to do a neck resection may at times be difficult to make, because frequently enlargement of the glands may be due solely to inflammatory causes and on the other hand, metastases may be present without palpable enlargement of the glands This accounts for the divergence of opinion among surgeons as to the feasibility of prophylactic resection According to Dr Ochsner the procedure is not necessary in cancer of the lip unless the lesion is greater than 3 cc. in size or is highly malignant Metastases to the glands are more frequent in lesions of the upper lip than the lower

In large lesions or anaplastic lesions without apparent gland involvement a unilateral supra hyoid dissection is indicated if the lesion is lateral if in the *midline, a bilateral resection would be necessary* In the presence of supra hyoid involvement a unilateral neck dissection is done or a bilateral dissection at different stages if the lesion is near the midline

Neck dissection in connection with carcinoma of the tongue or floor of the mouth may require a supra hyoid or unilateral neck dissection or even a bilateral resection *en bloc* with the mandible depending upon the location extent and type of the primary lesion

In no case is a neck dissection to be done unless the primary lesion is completely eradicated

DISCUSSION

Dr LeRoy A. Schall inquired as to the complications following resection of the carotid artery and vagus nerve in the complicated cases He had had five such cases in recent months

Dr. Henry Orton asked the essayist for his opinion regarding papillary cyst adenocarcinomas of the thyroid since there has been some difference of opinion as to proper therapy

Dr. Ochsner in closing replied that when it is necessary to resect the carotid artery they do so without fear of consequences because of the availability of grafts which can be immediately utilized Resection of the vagus is a cheap price to pay for the possibility of a cure Concerning the cystadenomas he feels that they are truly lymph node metastases from carcinoma of the thyroid rather than aberrant thyroids and should be dealt with by radical excision frequently bilateral. If the lesion is unilateral it is frequently impossible to palpate the orginal tumor in the thyroid In such cases he does a hemithyroidectomy including the isthmus. If a tumor is found in the thyroid they do nothing more but keep the opposite side under observation for a long time If no tumor is found they remove the other half of the thyroid and do a bilateral lymph node dissection. He feels that the earlier the lesion is discovered the more radical should be the resection since this is the best opportunity to obtain a cure.

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EVALUATION OF NECK DISSECTION IN CARCINOMA OF THE LARYNX.

Louis H Clerf, M D

In a series of 208 total laryngectomies Clerf found that metastases to the regional lymphatics occurred in 25 to 30 per cent of the cases The five-year survival rate in 34 cases where neck dissection was carried out was 26 4 per cent. Of the 33 not treated surgically but with irradiation only one survived five years, so that of the total 67 cases with metastases only 15 per cent survived beyond five years. Since 1940 he has been doing a neck dissection combined with the laryngectomy in a greater number of cases than formerly despite the absence of palpable lymph nodes, with a much higher percentage of survivals. He points out that the cases belonging to this category are those in which the lesion is supra or infraglottic, or where the arytenoid is involved and the mobility of the cord is definitely impaired Analysis of the group by five-year periods shows that cases where elective resection was done concurrently with the laryngectomy yield a much higher percentage of recoveries than those where a secondary resection was performed

DISCUSSION

Dr. Chevalier L. Jackson said he had every intention of discussing the paper but after hearing it found that he was in complete agreement with the author and could find nothing significant to add to it.

Dr. Julius W McCall inquired about complications following bilateral resection of the jugular veins. He had seen three such cases in which disastrous brain sequelae had been encountered

Dr. Edwin N Broyles was somewhat dubious about the necessity for gland resections in case of carcinoma of the larynx where the tumor was entirely intrinsic He had done resections in several cases without finding any metastases in the glands, on the other hand in cases where the peritracheal glands are palpable it is likely that the thyroid is also involved and of course in such cases radical dissection is indicated

Dr H H Harris (Houston, Texas) inquired whether Dr Clerf removes the thyroid gland *in toto* or only the half that appears to be involved

Dr. Andrew Eggston, as a pathologist brought up the point that frequently it is difficult to appraise the tissue submitted because the pathologist has no idea of the exact situation of the suspected node in the living state It would take days to go through the mass section by section to determine the exact location and extent of the metastasis since frequently it is limited to individual cells The surgeon who removes the tissue has a much better idea of its relationship to the original focus than has the pathologist Also a confusing factor is the presence of hemorrhagic foci indicating a noditis which might be mistaken for a metastasis Thus the difficulty in offering a prognosis based merely on the tissue examination

Dr Jerome A. Hilger called attention to the complete absence of mortality in the series presented, which speaks volumes for the excellent technique and postoperative care Increased interest in this type of surgery in recent years brings up the question as to the proper delegation of these cases Many men have reached the age when they do not care to expand into new techniques It points to the necessity for proper leadership and the expansion of educational growth among those who are still growing up in the specialty

Dr Clerf in closing pointed out that they did have mortality but not in the selective group The point is that elective block dissection in conjunction with laryngectomy when indicated does not enhance the mortality to any great extent

Bilateral dissections are fraught with some danger One case that survived complained of dizziness, had a florid complexion and marked scleral injection He ultimately died of metastases below the clavicle Certainly one cannot be too enthusiastic about bilateral block dissection yet as Dr Ochsner stated, it is not too great a price to pay if there is a chance to save a life

As to Dr Broyles comment Dr Clerf feels that if the patient has an extensive lesion even though there are no palpable metastases the chances for a permanent cure are much better if a unilateral block dissection is carried out since the added risk is minimal This attitude is prompted by the experience of having patients previously laryngectomized return with inoperable nodes in the neck Concerning metastasis to the thyroid the surgeon is definitely behind the eight ball The operative mortality is increased and the operative procedure prolonged Certainly the prognosis in such cases is not favorable. Concerning Dr Eggston s remarks Dr Clerf far from appearing critical expressed his deep appreciation for the contribution of the pathologist realizing the great difficulty of accurate and thorough study of all sections of the mass submitted a matter that is limited by the shortage of personnel as well as time limitations in most hospitals

MIXED TUMORS OF THE POSTERIOR PHARYNGEAL WALL

FRED Z HAVENS, M D

and

L C BUTLER, JR., M D

Mixed tumors of the posterior pharyngeal wall are very rare Havens and Butler were able to find only 41 cases over a period of 37 years at the Mayo Clinic. The majority occurred during middle life In 11 cases where the postoperative period was less than five years there was one recurrence In the 30 cases in which all but one were followed more than five years there were 24 with no recurrence, five recurrences three of which were successfully treated and two succumbing to the disease Most of the patients were operated on via the transoral route after preliminary ligation of the external carotid artery the mass including capsule being scooped out and the cavity left open with only an iodoform gauze pack. Several cases were operated upon via an external approach through the carotid area with primary closure. They believe that the danger of seeding is greater when the latter procedure is employed because of the closure of the operated cavity

DISCUSSION

DR. HENRY B ORTON mentioned a case seen recently in which it was necessary to remove a portion of the ascending ramus of the mandible because of the extent of the growth It was not necessary to ligate the carotid and the approach afforded much more room than would have been available via the intraoral route.

DR. HARRY P SCHENCK stated that the few cases he had seen were readily removed by the transoral route One case was interesting because it had been treated for some time as a peritonsillar abscess One of the dangers in removing these growths arises out of the fact that the normal mucosa overlying the mass has to be incised to reach the capsule which is attended by *the risk of* seeding and subsequent recurrence Hemorrhage in his experience has not been a disturbing factor Following removal one may be astounded by the depth of the resulting cavity Dr Schenck has practiced suturing from the bottom up and obtained very satisfactory cosmetic results

DR. ALBERT C. FURSTENBERG emphasized the importance of thorough eradication at the first attempt because recurrences are usually found in areas remote *from* the original focus, which increases the difficulty of removal Besides, the recurring growth is usually more malignant than the original

He agrees that seeding may be a very potent factor in the incidence of recurrences. It is therefore advisable particularly if the mass is in one of the salivary glands, to remove some of the tissue surrounding the capsule of the tumor even though it may appear grossly benign.

DR. DEGRAAF WOODMAN asked Dr Havens recommendations as to biopsies in view of the danger of seeding

DR. HAVENS closed the discussion by stating that he had at times been tempted to attack the tumor via the external route as suggested by Dr

Orton but had thus far not encountered a case when this procedure was imperative

As for ligating the carotid it depends on how readily one is alarmed which was the case in his own experience on several occasions He would therefore feel more secure if he ligated The matter of closing the defect is one that may be left to the individual Dr Havens does not suture but fills the cavity with iodoform packing which is removed gradually beginning on the fourth day The wound heals readily, and at a later date one can barely see the operated area He believes also that there is less danger of seeding

Dr Havens agreed heartily with Dr Furstenberg on the matter of adequate surgery at the first attempt This applies to all malignant tumors as well Concerning the question of biopsies he is in the habit of sending a biopsy specimen out after the capsule has been identified and the dissection partly completed As a matter of fact it makes little difference since the excision is going to be wide enough to encompass all the presenting mass

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VASOMOTOR RHINITIS

Theodore E Walsh, M D

Walsh has been unable to identify allergic factors in a large percentage of the cases of vasomotor rhinitis which he has observed In most cases the etiology is to be found in endocrine, dietary and psychosomatic disorders Hypothyroidism, often of the subclinical level, is very common and good results may be expected following the administration of thyroid extract in adequate doses In children dietary indiscretion such as the ingestion of excessive amounts of carbohydrates, is frequently the cause Emotional states should not be overlooked because in many instances they act as a trigger mechanism that sets off allergic manifestations in many individuals who are only mildly allergic without showing specific sensitivity

The author decries the continuous use of vasoconstrictors which only leads to subsequent turgescence He advises propadrine by mouth for temporary relief in addition to the care of such constitutional factors as have been mentioned

DISCUSSION

Dr Oliver E Van Alyea expressed his opinion that the condition described by Dr Walsh was a borderline or atypical allergy and might be considered as a separate entity A question he would like to raise apropos of therapy relates to the employment of cauterization of the turbinates in stubborn cases This is an old time procedure of which he does not approve

Dr Henry L Williams agreed that many of these cases are difficult to relieve It occurred to him that it might be possible to differentiate among them a little more accurately In his experience the cases with violaceous mucous membranes are usually the so-called low BMR without myxedema which can successfully be treated On the other hand the cases with watery discharge and relatively normal mucosa are not helped by endocrines, and are better classified as physical allergy The insistence of Dr Walsh on antigen antibody reactions is not in line with the think ing of immunologists The concept of physical allergy cannot be disproven and allergists are willing to admit that many of these cases which are clinically indistinguishable from true allergy do not yield a positive skin test The dietary regimen mentioned by Dr Walsh is reminiscent of Dr Sam Roberts work along these lines, which has proven to have great merit. As for cauterization mentioned by Dr Van Alyea Dr Williams has found it efficacious particularly if applied in the region of the sphenopalatine ganglion He has seen no ill effects from the procedure there being no permanent damage to the cilia and it affords relief for long periods of time.

Dr. Lowenthal called attention to possible emotional or psychiatric influences in these cases Frequently the patient will give a history of spastic colitis or some other derangement of the sympathetic nervous system. A pseudo-psychiatric approach may in many instances afford the key to a solution of the problem.

Dr. Walsh, in closing agreed that cauterization of the ganglion is free from harm and is not to be confused with cauterizing the turbinal, which may alter the physiology of the mucosa He personally likes injecting the ganglion which has given him some very good results. Concerning physical allergy Dr Walsh felt incompetent to discuss it adequately although he recognizes it as an entity however these cases are a minority in the group he was discussing He agrees that the psychosomatic approach has much to offer yet does not mean that they all must consult a psychiatrist. The solution to the problem lies in a thorough understanding of the patient as a whole knowing his background habits environment and emotional status. Frequently the trouble is due to a combination of factors aside from the purely allergic.

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A FEW HIGHLIGHTS CONCERNING RESPIRATORY CILIA.

G Edward Tremble, M D

The electron microscope has in recent years proven of great value in determining the structure of cilia. "Each cilium consists of a basal body which is imbedded in the cell. Just above the basal body a small cuticular ring can often be seen" The rings of adjoining cells seem to be attached to each other forming a thin plate The cilium itself consists of an axial fibrillar bundle and a semitransparent, thin peripheral sheath."

Much of the experimental work on animals is described in the article.

It is assumed by some that the activating agent which produces the ciliary beat arises in the basal bodies and is transmitted through the longitudinal fibrils to the tip of the cilia The question as to the exact origin of the cilia is still undetermined we do not know whether they grow from the surface of the cell or develop below in the basal body also still a mystery is the exciting influence which causes the ciliary beat.

DISCUSSION

Dr. August L. Beck recalled an early motion picture produced by the late Dr Mosher in which one cell had become detached and was still showing activity, the cilia continuing to beat in rhythm with the rest of the cilia along the main body of cells It reminded him of a soloist and orchestra in action through some unseen agency

Dr Arthur W Proetz called attention to the value of the electron microscope, which has in recent years vastly increased our knowledge of ciliary activity The time now is ripe for some genius to unravel the mystery of the true origin and nature of ciliary activity It requires not only the electron microscope but also an observer with imagination who can put together such facts as Dr Tremble presented along with other data The situation is almost analagous to the study of the circulatory system in which all the facts were known for years but not clearly understood until someone discovered valves which finally proved that the blood was going in one direction

Dr Tremble closed the discussion by acknowledging Dr Beck s comment about the continual activity of cilia even when the cell is detached This observation of Dr Mosher's has been corroborated many times since By having a patient with a cold blow his nose onto some wax paper and placing the secretion under the microscope one may frequently see detached cells with cilia still waving They will continue to wave as long as attached to protoplasm, kept warm and moist His object in bringing this subject before the Association was to emphasize the constancy of cilia throughout the animal kingdom as shown by comparison with spermatozoa with its fringe-like tail and the nine paired groups around the periphery with the two larger central ones just like the cilia in our own nasal mucosa

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THE RADICAL OBLITERATIVE FRONTAL SINUS OPERATION A CONSIDERATION OF TECHNICAL FACTORS IN DIFFICULT CASES

ROBERT L GOODALE, M D

Dr Goodale proposes a radical obliterative operation in which the Jansen Lynch Smith procedures are inadequate cases of extensive trauma, chronic osteomyelitis and recurrences following previous surgery The previous objections to this method namely the resulting deformity, can be overcome with modern plastic procedures The obliterating operation must be complete all mucosa and bony septums removed the duct destroyed and the ethmoids exenterated The posterior wall of the sinus is not removed unless apparently diseased or where there is a suspicion of some intracranial extension Eight cases are shown in which the excellent plastic repair of the defect demonstrates the fine cosmetic results obtained In most cases autogenous bone grafts were employed

DISCUSSION

Dr James M Robb said that Dr Goodale s paper has shown definitely that it is an erroneous concept to conclude that the sulfa drugs and antibiotics have completely done away with the necessity of operating on the frontal sinus

Dr W Likely Simpson felt that while 100 per cent perfect postoperative results were impossible the usual course after a proper procedure should be as good as that following a radical mastoid Such factors as the extent of the disease of the bone and membrane as well as the size of the sinus have a definite bearing on the post-operative course It is imperative that all of the mucous membrane be removed and the entire ethmoid area exenterated. As for osteomyelitis it is better to defer the definitive surgery until the acute process has been brought under control Through the usual brow incision the exenteration can be accomplished starting from the upper extension of the sinus and working downward The polishing burr is a useful adjunct in the finishing process Where the sinus extends far upward it is advantageous to make the incision at the supreme extremity which affords good access and which leaves very little scar or deformity Cases are frequently presenting themselves which require the type of surgery described by the essayist, and the individual surgeon should have the courage to go ahead when the case demands it

Dr. Francis W Davison recalled a technique described by Dr Jesberg a few years ago in which the floor of the sinus is removed along with the outer third or half of the anterior wall a procedure which is indicated and has been proven successful in the large or expanded sinus

Dr. James Maxwell stated that in recent years they have attacked the large frontal sinuses via a coronal incision which permits excellent exposure of the entire frontal bone and if the orbital ridges are removed, affords access to all the ethmoids and sphenoids He asked Dr Goodale whether with the brow and vertical incisions it was his practice to pack the wound wide open

Dr Goodale closed the discussion by first agreeing with Dr Robb that too much reliance has been placed on antibiotics by some surgeons particularly in chronic cases, gross infections etc besides, antibiotic therapy needs reviewing in the light of the emergence of resistant strains and new bacterial invaders Certainly the pyocyaneous and resistant staphylococcic infections call for more effective medicaments than at present available He was interested in Dr Simpson's use of the burr Having been trained in the use of gouge and rongeur he had clung to them because of his familiarity with them nevertheless, the idea of using the burr particularly from above, seems appealing The important point is to see that the utmost limits of the sinus are reached

He recalls one case of a chronic frontal sinusitis with a localized osteomyelitic process in which the Jesberg procedure worked out very well although some deformity did result.

He agreed with Dr Maxwell that the coronal incision can afford a wide exposure however in the cases he has presented it seemed more feasible to go through the incisions of the previous operations rather than make new ones. In the one case in which a vertical incision was used it was necessitated by the fact that after the Lynch exposure it was found that an osteomyelitic process was present not previously seen in the X rays.

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Motion Picture Film

REHABILITATION OF PATIENTS WITH CLEFTS OF THE LIP AND PALATE

(No formal paper)

(No discussion)

UNILATERAL CORD PARALYSIS

DANIEL S CUNNING, M D

Dr Cunning studied a series of cases of vocal cord paralysis observed at the Manhattan Eye, Ear and Throat Hospital over a period of 15 years. There were 163 males and 99 females, 82 involved the right cord and 180 the left The etiologic factor was found in 68 7 per cent of the group the remainder being unidentified Neoplastic and toxic or inflammatory lesions accounted for almost half the cases

A search for the etiologic factor must include a thorough physical, X ray, neurologic and serologic examination The causes are too numerous to mention since any lesion from the nuclear and supra nuclear areas in the brain and on down along the course of the vagus may affect the functioning of the nerve which may also be involved in any number of general constitutional disorders of a toxic nature

DISCUSSION

Dr Louis H Clerf recalled a statement made by Dr Kyle years ago that the general physician sees this condition from the systemic standpoint, while the specialist looks at it as a local affair which he often treats without realizing its significance Dr Cunning's statistics agree with previous studies namely, that neoplasms are the cause in two-thirds of the cases, the others being considered idiopathic While there is not much to be done for the neoplastic group, the laryngologist can be of great assistance to the thoracic surgeon who realizes that left sided paralysis due to thoracic lesions rarely is amenable to surgery Dr Gibbon, who has explored many of these cases has yet to find one which he could successfully extirpate Another interesting item is the occurrence of a left side paralysis five to ten years after a mastectomy indicating an inoperable mediastinal extension As to post thyroidectomy paralysis it indicates the importance of the surgeon learning more about the recurrent nerve The toxic group of cases is interesting since many of the idiopathic cases are of this nature, being probably due to a virus These cases offer a better prognosis than many of the others Dr Clerf agrees with Dr Cunning as to the value of speech therapy in some of these cases Surgery such as that recommended by Dr Morrison can be successful in improving the voice when the cord is abducted with poor tension

Dr Edwin N Broyles mentioned a case of spontaneous unilateral paralysis in which the examination offered no clue as to the cause until eight months later, when a mass developed in the thyroid region which proved to be malignant In another case of unilateral paralysis it was a year before a tumor of the mediastinum was diagnosed It might be feasible in such cases to explore the left recurrent nerve and follow it down into the chest in the hope of finding the lesion It is his opinion as well as that of surgeons of his acquaintance that tumors of the thyroid causing a recurrent paralysis are usually malignant As for patients being improved by speech therapy, this may be true of the speaking voice but is usually ineffective insofar as the singing voice is concerned

Dr C L Jackson reported having seen two cases on successive days in which the etiology could not be determined He inquired whether Dr Cunning had had any results from medical therapy in the toxic or inflammatory cases

Recurrent paralysis following diverticulectomy had disturbed him in several cases and he wondered whether the essayist had anything to offer by way of preventing this complication.

DR. JULIUS W McCALL thought that unilateral paralysis caused a voice weakness rather than a true hoarseness because he has observed that these patients have a better voice in the morning than later in the day

DR. BENJAMIN SHUSTER mentioned a case in which neurologic findings pointed to a brain tumor however a more careful study of cranial nerve function and the reaction to skin stimuli revealed a loss of sensation on one side which pointed to a spinal thalamic involvement on the side opposite the cord paralysis.

DR. FRANCIS L. WEILLE asked Dr Cunning whether he attached any significance to the anastomotic branch from the superior to the inferior laryngeal nerve insofar as explaining the position of the cord after injury

DR. CUNNING closed the discussion first by evaluating what he called hoarseness. The character of the voice in larynx lesions often varies with the lesion within wide limits So far as he is concerned he can only call it hoarseness though in some cases it may be partly fatigue

It is true that about 10 per cent of the cases are caused by cerebral or spinal lesions and therefore it is always important to check all the reflexes for possible signs pointing to the side of the lesion As for medical treatment, they have used iodides, vitamins and Cortisone all with no effect There were no cases of paresis complicating diverticulotomy in his series.

There is no question that the laryngologist is up against it in so many cases because of the difficulty in discovering the etiology These patients often go for years with no other symptom than the hoarseness.

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TEN YEAR PROGRESS OF LARYNGOFISSURE OPERATION

MERCER G LYNCH M D

Experience with the laryngofissure operation in recent years has yielded a higher percentage of cures up to 90 per cent. This has been accomplished through wider excision of tissues. Where the commissure has been involved a portion of the cartilage is removed and the excision extended into the opposite cord The possibility of a web resulting is not viewed with any alarm since the McNaught procedure with the tantalum plate has proven its worth Dr Lynch does not recommend its being done at the primary operation because of the granulation tissue which springs up in abundance from the irritation of the tissues by the metal It is better in these cases to await scar formation before attempting to insert the tantalum plate Laryngofissure can be successful even in cases where the growth has extended as far as the vocal process and even when mobility of the cord is limited however if the arytenoid itself is involved or mobility is definitely limited one would have to choose laryngectomy in preference It is important to resect well beyond the apparent lesion and Dr Lynch recommends following the surgery with the application of electrodessication also he calls attention to the fact that tracheotomy is not resorted to which materially reduces the postoperative period

DISCUSSION

DR CHEVALIER L JACKSON was glad that Dr Lynch had raised his voice in favor of the laryngofissure operation The indications for it have broadened rather than contracted because of broadened techniques The elder Jackson's technique of removing anterior commissure lesions has been improved since Broyles described the anterior commissure tendon, so that now, instead of cutting the cartilage in the midline the incision goes through the healthy side thus permitting excision of the midline cartilage along with the lesion Regarding web formation following thyrotomy, he has found the procedure suggested by Dr Gabriel Tucker of value namely, anchoring the epiglottis forward with a suture in all cases where its attachments have been severed, also, Dr Jackson pointed out that this operation should really be termed a partial laryngectomy rather than a laryngofissure

DR HENRY M SCHEER called attention to a procedure described by his son, in which the laryngofissure approach was employed for the relief of a bilateral abductor paralysis One paralyzed cord was tied back with a wire suture, and the patient for three years was still breathing comfortably through the larynx

DR. LYNCH, in closing, stated that he does not favor a hemilaryngectomy in cases where the midline incision is not indicated He would prefer laryngectomy in such instances With regard to web formation, he has not employed Dr Tucker's procedure but has used the tantalum splint with good results As for Dr Scheer's operation, Dr Lynch recalled the submucous dissection of one cord reported by Dr Hook of Boston in which some good results were obtained

(To be concluded in the November Issue)

THE VIRGINIA SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

The Virginia Society of Ophthalmology and Otolaryngology will have its annual fall meeting in Richmond at Baruch Auditorium in the Medical College of Virginia, Nov 29th and 30th (Otolaryngology) and Dec 1st and 2nd (Ophthalmology)

The speakers for the Otolaryngology program are Drs Victor Alfaro, Lawrence R Boies, Aram Glorig, Robert J Huebner, Lyle M Sellers, Ben Senturia, and Henry L Williams

The speakers for the Ophthalmology program are Drs Howell W Brown, James Spencer Dryden, Wm M Hart, Wm Howard Edward Norton, and Henry P Wagener

Additional information may be had by writing Dr P N Pastore, Box 25, M C V Station, 1200 E Broad Street, Richmond 19, Va

DALLAS ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

PROGRAM 1955 - 1956

Tuesday, November 1 1955

Amon Carter Airport — Private Dining Room

Joint Meeting with Fort Worth E E N T and Dallas O and O

Dr Harold F Schuknecht, Detroit, Mich
Associate Surgeon, Henry Ford Hospital

3 30 P M —Program Meniere's Disease
4 30 P.M —The Management of Carcinoma of the Upper Respiratory Tract
5 30 P M —Cocktails, Courtesy Alcon Laboratory
6 30 P M —Dinner honoring Dr Schuknecht
7 30 P M —The Clinical and Experimental Aspects of Perceptive Deafness

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II INTERNATIONAL CONGRESS ON ALLERGOLOGY

The II International Congress on Allergology will be held in Rio de Janeiro, November 6-13, 1955 The most outstanding authorities on the matter will be present at this meeting with a view to submitting and considering the following official subjects Histamin and Mechanism of the Allergological Reactions—(histamin, its metabolism and its role on the allergology, histamin releasers Drug Allergology, including the antibiotics) Immunology and Allergology (chemical compositions of the antigenes and antibodies, immunological quantitative technics applied to allergology) Asthma (physiopathology death through asthma, climatic asthma) Dermatological Allergology (including industrial and contact dermatitis) Allergology and Verminosis Allergology and Leprosy Allergology and Tuberculosis Allergology and Hormones

Prior to the opening of the Congress, on November 3-5, an international and intensive course on allergology will be held, in which about thirty famous scientists will participate The Congressists by addressing themselves to the Congress Secretary-General, will be considered as registered in this course All other interested parties (physicians or medical students) are requested to register their names, in due time, at the General Secretariat

Registration fees U S $15 00 Accompaniers U S $6 00 each

For further information and registration, please apply to

Secretaria Geral do
II CONGRESSO INTERNACIONAL DE ALERGIA
Avenida Rio Branco 277, 7° andar—grupo 705
Rio de Janeiro - Brasil

THE VIRGINIA SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY CONVENTION CRUISE

The Virginia Society of Ophthalmology and Otolaryngology is sponsoring a convention cruise to Havana and Nassau on May 26 to June 2, 1956 Sailing from and returning to Norfolk, Virginia, the "Queen of Bermuda" will act as the hotel for the trip Fare for seven days, $165 00 and up per person Make reservations with United States Travel Agency, Inc., Washington, D C

STANFORD UNIVERSITY SCHOOL OF MEDICINE POSTGRADUATE COURSE

A Postgraduate Conference in Otorhinolaryngology will be presented by the Division of Otorhinolaryngology, Stanford University School of Medicine, March 26-30, 1956 This Conference will offer a comprehensive survey of the current field of Ear, Nose and Throat Presentations will be didactic, by individuals and panel-groups Some of the subjects will be basic science reviews such as anatomy (using three-dimensional projection) and pathology, audiology including psychogalvanic skin response, ear surgery, including stapes mobilization, nose and sinus problems, including rhinoplasty, pituitary surgery, allergy and steroid therapy, throat diseases including suspension laryngoscopy, laryngoplasty (*e g* use of tantalum plate), and laryngectomy with neck dissection, speech problems bronchoscopy and esophagoscopy etc.

Registration is limited to 30 Doctors of Medicine in E N T or E.E N T, and the fee is $100 00 Application may be made to Office of the Dean, Stanford School of Medicine, 2398 Sacramento Street San Francisco 15, California

NATIONAL SOCIETY MEETINGS

Schedule of Meetings for 1956

Eastern Section, to be held at the Statler Hotel, Boston, Mass, January 18

Middle Section, to be held at the Netherlands Plaza Cincinnati, Ohio, January 16

Western Section, to be held at the County Medical Society Bldg San Francisco, Calif January 21

Southern Section, to be held at the Shamrock, Houston Texas, January 27-28

American Board of Otolaryngology, to be held at the Sheraton-Mt. Royal, Montreal Canada May 6-11

American Otological Society, Inc to be held at the Seigniory Club Montreal Canada May 11-12

American Laryngological Association to be held at the Seigniory Club, Montreal, Canada May 13-14

American Broncho-Esophagological Association, to be held at the Sheraton Mt Royal Montreal, Canada, May 15-16 (afternoons)

The American Laryngological, Rhinological and Otological Society, Inc., will hold its Annual Meeting at the Sheraton Mt. Royal, Montreal, Canada, May 15-16-17 (mornings only)

Please make early plans to attend the 1956 Spring Meetings in Canada Both the Seigniory Club and Montreal present most attractive features for you and your family More information about the places will be told to you

Reservations at the Sheraton-Mt. Royal Hotel should be made early by addressing the Reservation Supervisor, 1455 Peel Street, Montreal, P Q Canada

COURSE IN RECONSTRUCTIVE SURGERY OF THE NASAL SEPTUM AND EXTERNAL PYRAMID

Under the joint sponsorship of the Departments of Oto-Laryngology of the L S U School of Medicine and Tulane School of Medicine a course in Reconstructive Surgery of the Nasal Septum and External Pyramid will be presented in New Orleans March 10-17 (inclusive), 1956

The course will be given with the cooperation of the American Rhinologic Society and under the direction of Dr Maurice H Cottle

The assisting guest faculty will include the following Drs Walter J Aageson, Fred W Beck, Max Bornstein, James Chessen, George G Fischer, Irwin E Gaynon, Harvey C Gunderson, Richard B Hadley, Robert Hansen, Kenneth H Hinderer, John A Kirschner, Walter E Loch, Roland M Loring, Joseph Ogura, Charles J Puerillo, Ivan W Philpott, Ralph H Riggs, Pinckney W Snelling, Carl B Sputh, Jr, and Russell I Williams

Applicants must be diplomates of the American Board of Oto-Laryngology Class limited Apply to Dr Clifford G Grulee, Jr, Director of Graduate Medicine, School of Medicine, Tulane University, 1430 Tulane Avenue, New Orleans 12, Louisiana

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BRONCHOESOPHAGOLOGY COURSE

The next Bronchoesophagology Course to be given by the University of Illinois College of Medicine is scheduled for the period October 24 to November 5, 1955, under the direction of Dr Paul H Holinger

Interested registrants will please write directly to the Department of Otolaryngology, University of Illinois College of Medicine 1853 West Polk Street, Chicago 12, Illinois

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(Secretaries of the various societies are requested to keep this information up to date)

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Meeting Fifth Pan American Congress of *Oto-Rhino Laryngology* and Broncho Esophagology
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Basic Sciences in Otolaryngology
September through June

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*Our subscribers are asked to send us information on other institutions giving such courses

THE

LARYNGOSCOPE.

VOL. LXV NOVEMBER, 1955 No 11

REVIEW OF THE AVAILABLE LITERATURE ON THE PHARYNX AND PHARYNGEAL SURGERY FOR 1954*

FRANCIS E LEJEUNE, M.D ,

and

MERCER G LYNCH, M D ,

New Orleans, La

PHYSIOLOGY

Cole[1] performed experiments designed to measure temperature and humidity of respiratory air He found that samples of inspiratory air from the oropharynx contained about 25 per cent less water and were about 4°C cooler than air saturated with moisture at body temperature The respiratory rate did not alter these figures A body mechanism for conservation of heat and moisture is demonstrated

In an interesting discussion Calnan[2] called attention to "The Error of Gustav Passavant," whose theory of velopharyngeal closure has been accepted without question for nearly a century Passavant's life is briefly reviewed and his presentation on "closure of the pharynx in speech" is critically analyzed There was no clear concept of the action of the soft palate until Passavant presented his classical paper in 1869

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*From the Department of Otorhinolaryngology Ochsner Clinic, New Orleans.

Editor's Note: This ms received in The Laryngoscope Office and accepted for publication, September 23 1955

To him must be given the credit for showing that the velum is a muscular structure which moves in a definite way

Passavant advanced the theory that the annular bulging of the posterior pharyngeal wall caused by the bulging of the superior constrictor masseter, just slightly above the level of the velum, causes the palate flap which is essential for intelligible speech Support for Passavant's theory was given by Browne, Oldfield, Dorrance, Wardill and Stein, whereas objections were voiced by van Lushka, Victor Veau, Borel Maisonny and Wood-Jones Five additional objections are advanced by Calnan based on clinical and radiologic evidence That Passavant's ridge can and does occur in association with cleft palate is recognized, that it is a factor in normal speech is vigorously denied by Calnan

PATHOLOGY

Semenov[3] presented a thorough, interesting study of the pathology of the pharyngeal recess, Eustachian tubes, tonsils and adenoids He pointed out that the fossa of Rosenmueller, a deep pocket in the uppermost corner of the nasopharynx, is in addition a hidden trap first, because of its great depth, second, because it contains a mass of adenoid tissue, third, because malignant growths arising in this location metastasize quickly, fourth, because cryptic infection is more common here than is generally supposed, and finally, because this is the origin of many colds and nasopharyngeal infections

The histology, physiology and applied pathology of the nasopharynx, Eustachian tubes, tonsils and adenoids are well discussed The problem of irradiation of the nasopharynx and the microscopic examination of the irradiated tissue is well presented Semenov agreed that a good adenoid operation is difficult to perform and stated that adenoid tags are more common than tonsillar tags Adenoids occur in adults as well as in children and they should be removed when they cause signs and symptoms of disease Semenov posed an interesting question A million or more tonsillectomies are performed in the United States every year If a single tonsil weighs 3 Gm and an adenoid 2 Gm , how many pounds or even tons of lymphoid tissue are removed during our lifetime? This is a well illustrated and prepared article which cannot be easily summarized To appreciate it one must read it in its entirety

BACTERIOLOGY

Goldman and associates[4] made a study of the nasal flora in 50 normal children and in 50 children with nasal infections They noted that cultures taken from the nose and nasopharynx of children showed the same nonpathogens as those from adults In disease, cultures from children also corresponded to those from adults The nasopharynx of children harbors pathologic organisms which under certain circumstances lead to sinusitis or laryngotracheo-bronchitis

The aerobic flora of the nasopharynx and stools were studied by Stoppelman and Schwachman[5] in 140 patients with mucoviscidosis who had received antibiotic therapy continuously for a period of as long as six years These observations confirm previous conclusions that despite the resistance in the nasopharynx to antibiotic therapy, satisfactory clinical response may still be obtained

DIAGNOSIS

Fletcher and associates[6] described a supplemental aid to clinical examination of the laryngopharynx which may be of particular value in determining the site of origin of tumors in this region Invasion and perforation of the thyroid cartilage, and extension of the tumor into the pre-epiglottic space cannot be determined by indirect laryngoscopy but may be readily discovered by radiologic examination The latter might also be helpful when edema and the tumor prevent visualization of such structures as the pyriform fossa and subglottic space. A lateral soft tissue view and tomographic frontal sections of the laryngeal region form the basis for three dimensional study of the larynx *in situ*

Topography is particularly useful in the following conditions *1* Ulceration of the epiglottis and invasion of the pre-epiglottic fossa (which makes panlaryngectomy mandatory) *2* Destruction of the thyroid cartilage which may be manifested by disorganization of the calcification pattern of the thyroid cartilage These calcifications are normally very irregular, and less extensive in females than males This, together with other factors, must be considered when interpreting the roentgenograms Cartilaginous destruction makes postoperative Roentgen-ray therapy imperative *3* Subglottic extension, which is demonstrable on the tomogram and may show active subglottic disease in cases in which this area cannot be visualized by indirect or direct means because of an anterior (postoperative laryngofissure) web, overhanging tumors or edema

Fletcher and associates classified laryngopharyngeal tumors according to site of origin *1* Endolaryngeal, *2* brim of laryngeal inlet and, *3* pyriform sinus They believed this important because of the variations in biologic behavior of tumors originating at different anatomic sites Accurate determination of the site of origin leads to a more intelligent therapeutic approach Tomograms, by showing tumor extension, may provide the clue to site of origin in difficult cases, particularly in extensive growths

O'Bannon and Grunow[7] pointed out that radiographic examination of the larynx and pharynx is a simple procedure, requiring no special apparatus or inconvenience to the patient, moreover, much may be gained from this type of examination to substantiate the clinical findings and to aid in diagnosis The authors also made radiographic examinations as a means of determining sex, age of ossification and ossification centers, but nothing special could be concluded in this regard They theorized that ossification begins in persons early in the second decade of life, and the pattern is inherited and individual in each person

DISEASES

Ozena and rhinitis sicca were treated by Standbygard[8] with large doses of vitamin A The preparations used were Arovit (Hoffmann-LaRoche) in ampoules with 1 cc. of oil suspension containing 300,000 I U and tablets of 50,000 I U , 300,000 I U was given twice weekly and 0 to 4 tablets were given during intervals Of 35 patients thus treated 27 were rendered asymptomatic in two to three months Nine cases are reported in which the response to Arovit therapy was favorable There were three additional patients whose disease proved refractory to this treatment.

Eberhart and Socarides[9] are convinced that angioneurotic edema of the pharynx is caused by psychologic factors They reported a case of swelling of the larynx and pharynx following emotional disturbances Conflict of personalities with superiors invariably brought on fullness and choking sensations. This responded satisfactorily to administration of epinephrine and ephedrine, and also to the antihistaminic drugs if taken early in the attack The authors found that psychotherapy through reassurance served to ward off attacks for one and one-half years. Allergic studies yielded negative results, and although psychotherapy has not eliminated all attacks, it has reduced and minimized them considerably

Stoppelman[10] conducted a study of the effect of antibiotics on the nasopharyngeal flora of premature infants, while the Infants' Hospital in 1948 inaugurated a method of therapy whereby every premature infant admitted was routinely given penicillin, and either sulfadiazine or streptomycin in relatively large doses for the first five or ten days following admission The effect upon mortality appears to have been favorable

A similar regimen was conducted simultaneously at the Boston Lying in Hospital Cultures from the nose and throat were frequently sterile for the first 24 hours after birth Routine cultures were obtained from the nasopharynx on the first, third, fifth and tenth days A significant reduction in the incidence of streptococci was noted, whereas staphylococci were unaffected It is difficult to evaluate this study, as reports on findings in normal infants are completely ignored

Tamari and Orrico[11] reported two cases of infection of the pharynx with abscess which occurred in children of the same mother but different fathers The infection in the middle ear and the complications began in both children almost at the same age, and the complications in both were similar The authors believed that spread of the infection toward the pharynx in both cases probably was induced by progression of the inflammation along the bony and cartilaginous wall of the Eustachian tube The retropharyngeal abscess probably developed along the lymphatics of the parotid gland fascia and extended to the pharyngo-maxillary space by way of the pterygoid facial compartment

Norris and Armstrong[12] presented a most unusual and interesting case of membranous cryptococcic nasopharyngitis Cryptococcosis may produce pulmonary infections, deep seated abscesses, cutaneous lesions, and frequently in Southern countries low grade fatal meningitis According to the authors the condition is also known as torulosis, or European blastomycosis, and a Busse-Buschke disease

Norris and Armstrong stated that we are now seeing more and more patients suffering from fungous infections, and this is thought to be due possibly to the prolonged use of antibiotics A case is presented which is thought to be the first reported case of its kind The patient had a low grade fever and painful throat Examination disclosed a creamy, jelly-like membrane involving the uvula and nasopharynx Cultures established the diagnosis Local applications of gentian violet and hexylresorcinol and administration of achromycin and potassium iodide gradually cleared up the stubborn infection In addition, the patient had eight intramuscular injections of bismuth salicylate in oil with chlorobutanol The authors suggested use of similar medication in similar cases, and believed that such therapy might well be life-saving agents

Parrott and associates[13] described an illness characterized by pharyngitis, rhinitis, fever, cervical or submandibular lymphadenopathy, conjunctival inflammation and hepatic tenderness, which occurred in four children and four adults among the patients and staff of a hospital service This infection of adenoidal, pharyngeal, conjunctival virus, type 3, was contracted by these people shortly after a child was admitted to the service with this disease

Morse and associates[14] described a method of production of group *A* streptococcal pharyngeal infections in rabbits which affords another means of studying effects of repeated group *A* infections under conditions similar to those that occur in man They observed that after intrapharyngeal inoculation, transient bacteremia usually occurred, followed by fever to 48 hours, and significant rises in *ASO* titers one month later Bacteria were found in pharyngeal tissue at 48 hours, and small abscesses developed in some instances McMath and Pereira[15] reported a case of fatal rupture of a retropharyngo-esophageal abscess in a previously healthy 10 year-old girl The child was hospitalized after an illness of one week, which had been diagnosed as acute pharyngitis with severe cervical lymphadenitis Eight hours after admission the child suddenly became cyanotic, stopped breathing and died, despite tracheotomy and other resuscitative measures Autopsy revealed an extensive abscess involving the posterior pharyngeal wall from the uvula down to the arch of the aorta Rupture had been into the pharynx with flooding of the trachea and bronchi with pus No evidence of a foreign body was found

In recent years fluoroscopic and radiographic studies of the movements and contractions during the act of swallowing have been undertaken with increasing frequency From a diagnostic, prognostic and therapeutic point of view this method is increasing in value and fame Thulin and Welin[16] reported three cases of unilateral hypopharyngeal paralysis, studied radiographically All showed typical changes of filling and stretching of the hypopharynx on that side, however, the cause of the paralysis cannot be determined from this type of examination and, therefore, direct examination should be done in all cases

Fisher[17] noted the frequent occurrence of adhesions in the fossa of Rosenmuller These produce postnasal drip, weariness between the eyes, inability to concentrate, and nasal fullness and obstruction. Relief of these symptoms is obtained by breaking up these adhesions Several interesting cases are cited

ATRESIA.

McDonald[18] reported two cases of atresia of the nasopharynx, one resulting from infection and ulceration followed by adhesions and scarring and the other from tonsillectomy and adenoidectomy He employed the MacKenty procedure with good results in both cases

DIVERTICULA

Slade[19] reported three cases of peptic ulcer occurring in association with pharyngeal diverticula. No previous reference to this association has been found in the literature None of the patients was cured following operation for peptic ulcer until the diverticula were also corrected

Jesberg[20] stated that there are few subjects in medicine in which there has been as much confusion, perpetuated inaccuracy and misinformation as pulsion diverticulum of the hypopharynx That a pulsion diverticulum in this region should be considered as a lesion of the esophagus is anatomically erroneous, according to Jesberg He even objected to the terminology of pharyngo-esophageal diverticulum He thoroughly reviewed the literature and made appropriate comments regarding it

He then reported an interesting case of a bilobed diverticulum of the hypopharynx which was successfully excised At operation no reason could be found for the variation in the shape of the diverticulum The diverticulum opened anteriorly and to the right of the esophagus This is at variance with the usual area from which diverticula develop In all that we have seen or read about diverticula, they invariably developed on the posterior pharyngeal wall in a triangular area formed by the oblique fibers of the inferior constrictor of the pharynx and the orbicular fibers of the cricopharyngeus muscle, therefore the diverticulum is also unusual because of its origin, which is different from other reported cases

According to Wing[21], pharyngo-esophageal diverticula are three times more common in males than females, and occur more often in those past the age of 50 years He reviewed this condition and reported three cases, which were successfully corrected by the one-stage technique Wing removes the Levine tube on the seventh day, because he fears that it will cause pressure necrosis at the suture line It is our opinion that an indwelling tube can be safely removed on the fifth or sixth day, and we have not seen any cases of necrosis resulting from pressure of the tube

FOREIGN BODY

T'Ang[22] reported an unusual case of a foreign body in the nasopharynx of a 15-month-old baby The foreign body was a Chinese thimble, which is a wide metallic ring with proper [illegible]. Two months prior to discovery of this foreign body the parents suspected the child had swallowed the object. Roentgenograms of the entire gastrointestinal tract at that time revealed no evidence of foreign body. Bilateral otorrhea stimulated further examination, and it was noted the soft palate was pushed forward slightly. Mirror examination of the nasopharynx disclosed the foreign body, which was removed without difficulty.

Arnold and Som[23] reported an interesting case of a foreign body lodged in the posterior pharyngeal wall at the level of the third vertebra. A stabbing pain in the throat indicated the object was sharp, and dysphagia and dyspnea soon developed. Roentgenography showed a metallic wire-like foreign body 1.5 inches long extending transversely across the pharynx. Better roentgenologic localization was obtained by attaching Michel clips to the posterior pharyngeal wall in the locality where the foreign body was suspected. Arnold and Som stated that without use of the suspension laryngoscope removal of the foreign body would have been extremely difficult.

INJURIES.

Birsner and Leask[24] pointed out that the significance of swelling of the retropharyngeal soft tissues in the presence of fractures and/or dislocations of the cervical spine has been stressed, but that swelling of the retropharyngeal soft tissues due to "whiplash" injury without radiographic evidence of fracture and/or dislocation has not previously been reported. The "whiplash" injury is usually incurred from automobile accidents and is due to sudden deceleration.

Birsner and Leask briefly reviewed the normal limits of soft tissue spaces of the neck and reported nine cases of severe swelling of the retropharyngeal soft tissues due to "whiplash" injury. Their observations indicate that the thickness of the retropharyngeal soft tissues may be of value in further determining the exact degree of trauma both to the soft tissues and to the bony component of the cervical spine. Swelling in this area is of particular importance in the absence of radiographic evidence of fracture, and is indicative of hemorrhage or edema.

Brisner and Leask indicated that routine roentgenograms of the cervical spine should be made in all patients with severe injuries to the neck, and if there is any indication of swelling of the retropharyngeal soft tissues, a second lateral view should be taken in 24 hours This is important, as radiographic findings indicate this type of injury might be related to late degenerative changes in the cervical discs and that it may also be a causative factor in the formation of osteophytes which are so characteristic of late results of trauma Since swelling of the retropharyngeal soft tissues occurs in the absence of fractures, it may be the only concrete evidence of injury It would, therefore, be an index to the degree of trauma and of major importance from the medicolegal aspect

ROENTGENTHERAPY

Bordley[25] advocated the practice of more and more preventive medicine, especially in school children 8 to 13 years of age Children showing a decrease in hearing have been greatly benefited by use of nasopharyngeal irradiation This is used only in children showing regrowth of adenoid or lymphoid tissue about the orifice of the Eustachian tube Large central adenoid masses should be removed

Meltzer[26] discussed the histology, physiology, anatomy and pathology, as well as the endocrinologic aspects of recurrence of lymphoid tissue He presented arguments in favor of and against irradiation and radium He concluded that surgical treatment often repeated, followed by irradiation and, if indicated, allergy studies, offers the best chances of return of hearing in patients with blockage of the Eustachian tube by lymphoid tissue

Hardy and Bordley[27] made a controlled study on the effect of nasopharyngeal irradiation in about 5,428 children After five years 385 of the original 582 in the study group were reexamined to determine the effectiveness of radiation, to study the changes in hearing acuity, and to study the effects of puberty on lymphoid growth There was evidence that irradiation reduces lymphoid tissue The gain in hearing was more noticeable in the treated than in the control group At puberty improvement in hearing takes place, which is due to change in the condition of the lymphoid tissue

It is well known that patients exposed to radiation who are not properly protected are subject to radiation cancer Raven and Levison[28] reported a case of radiation cancer of the hypopharynx following radiotherapy for thyrotoxicosis

SURGERY

Beavis[29] considered one of the most controversial problems of all times to be the reconstructive management of clefts of the muscular velopharynx. He reviewed the history of cleft velum from earliest literature, and attempted to select those methods which have the most practical application The palatopharyngeal muscular mechanism is an extremely intricate one, and this anatomic area is well discussed Adequate illustrations help to describe the surgical procedure most practical in the reconstruction of palatal defects This is one of the best presentations of a difficult subject The results obtained warrant the meticulous care and study of the subject matter The development in practical treatment of split palate and velopharynx from 1018 to 1946 is given.

DeLisa[30] proudly stated that he had had no cases of postoperative hemorrhage following adenoidectomies since he began irrigating the nasopharynx with cold saline solution at the conclusion of the operation With the suction tip in the pharynx, both nostrils are flushed with a 60°F saline solution This irrigation is repeated until complete hemostasis is obtained. Incomplete removal of tissue is the commonest cause of postoperative hemorrhage

Goligher and Robin[31] devised a technique elevating the mobilized left colon to the upper pharyngeal remnant after pharyngectomy They advocated freeing the colon in two stages. They reported a case in which antethoracic esophagopharyngoplasty using the left colon was successfully employed to restore continuity with the stomach after pharyngectomy for carcinoma of the pharynx In a good summary of the literature they mentioned the Trotter and Wookey operations as well as those of Harrison, Robertson and Sargent.

BENIGN TUMORS

Martin[32] presented a general discussion of the main facts known about nasopharyngeal fibroma, and discussed pathologic and clinical features He believed that surgical treatment has been retarded for lack of a useful approach to the tumor He considered the transpalatal approach satisfactory in most cases It is still difficult to remove the tumor by this approach, but it is the best available approach Martin thought that diathermy removal of as much of the tumor as possible by this route may prove to be an important advance in the management of these patients In excessively vascular tumors which have been incompletely removed, Martin advocated the palatal fenestration operation without delay The technique is described

Kremen[33] presented a new surgical approach for the management of nasopharyngeal fibromas These tumors occur mostly in young pubescent males producing symptoms of nasal obstruction, vocal and auditory changes and dangerous bleeding They grow progressively through adolescence, and after maturity the vascular channels become obliterated and the tumor regresses Recurring hemorrhages and expansion of the tumor force these patients to seek relief The various methods of therapy are briefly reviewed, and the conclusion is reached that none are entirely satisfactory

For this reason Kremen devised a new approach in which a vertical incision is made in front of the ear and down the neck anterior to the sternocleidomastoid muscle, and then a horizontal incision is made beneath the angle of the mandible joining the vertical incision The external carotid is ligated and the lower pole of the parotid gland is dissected free The masseter muscle is severed and the mandible is transected one centimeter below the notch formed by the coronoid and condyloid processes Blind dissection is carried through the internal pterygoid muscle, and the tubulomuscular wall of the nasopharynx is incised longitudinally on its lateral wall to expose the tumor The tumor is then removed, and bleeding is controlled by packing, and in closing, the edges of the mandible are wired together Kremen reported two cases successfully treated by this technique

The author deserves credit for the ingenuity of devising this approach, which undoubtedly has merit The approach seems to be radical considering that less formidable operative procedures have proved successful through the years

From a study of 25 cases of juvenile nasopharyngeal angiofibromas Sternberg[34] found that though these tumors have a variable histologic pattern, they have an underlying basic vascular structure The cause of these tumors is not known, but Sternberg believed that they are probably influenced by some as yet unknown endocrine factor He based this view on the fact that nearly all angiofibromas occur during adolescence there are rare instances of spontaneous regression, and they occurred only in males in his series

Gundrum, Stambuck and Gaines[35] reported a case of choristoma of the nasopharynx, and perusal of the literature failed to show a similar reported case This tumor in a newborn infant produced obstruction to nasal breathing and swallowing On examination a grayish movable mass was found in the nasopharynx and was easily removed surgically

Gundrum and associates believed, as do several others, that this type of tumor "represents a displacement of tissues in the course of development, so that they appear in a neighboring area.' If this is correct, they conclude that choristomas are true neoplasms, however, in his original description of the lesion Albrecht described the choristoma as a misplaced anlage, and did not believe it to be a true tumor

Stewart[36] reported a rare case of neurofibroma of the pharynx with other neurofibromas of the neck and left leg

Hemley, Schwinger and Friedman[37] described juvenile nasopharyngeal angiofibroma as a distinct clinical entity almost exclusively limited to adolescent males It is an active fibrovascular tumor, pathologically benign in spite of having the ability to erode The extreme vascularity of these tumors is responsible for the fact that epistaxis is the most common complaint. Because of this vascularity, operation is always hazardous and radiation is frequently employed to help decrease the vascularity of the tumor The authors advocated the use of androgens with the hope that the sexual maturity thus induced might decrease the vascularity of the tumor The tumor tends to regress with adult life The prognosis as to life is excellent

Unilateral branchiogenic nasopharyngeal cysts are rare, and bilateral ones have not been heretofore reported Taylor and Burwell[38] reported two cases each of unilateral and bilateral branchiogenic nasopharyngeal cysts The question of their branchiogenic origin and embryologic derivation is discussed at length Good results followed treatment consisting of injecting the cysts with a sclerosing solution

Handousa and coworkers[39] reported their experience with 70 cases of nasopharyngeal fibroma, which is the commonest benign growth found in the nasopharynx They estimated the incidence of nasopharyngeal fibromas in Egypt to be one in 50,000 patients, which is less than that reported for other countries A good discussion of the origin, extension, symptoms and treatment is given

Handousa and associates are not in agreement with the opinion of some that spontaneous regression occurs uniformly at the time of sexual maturity They did, however, agree that irradiation reduces the vascularity and size of the tumor They advocated surgical excision, believing that the dangers of the operation have really been over-estimated, however, in the next paragraph they stated that at operation hemorrhage can be so profuse as to be fatal Moore's lateral rhinotomy approach was used by choice, and excellent results are reported

Pathologists have long been concerned with the etiology and pathogenesis of the various lymphoid diseases According to Friedberg and Hass[40], the initial manifestation of certain lymphoid disorders may be a tumor of the nasopharynx or pharynx The finding of any abnormal or recurrent mass of lymphoid tissue in the nasopharynx, of a smooth unilateral swelling of the lateral pharyngeal wall, or unilateral tonsillar hypertrophy should arouse suspicion as to the possibility of a lymphoma Friedberg and Hass reported 10 cases of lymphomas in detail, with interesting comments following each case report They expressed the opinion that an accurate diagnosis can be established only by biopsy, and if cervical node enlargement exists it is highly desirable to obtain one for examination In all their cases irradiation was used, and in some it proved to be of great benefit

In an excellent discussion Dane[41] agreed that the etiology of nasopharyngeal fibroma is still unsolved and reviewed several theories previously advanced The symptoms and clinical course of these tumors are described It is unanimously agreed that only patients with definite symptoms should be treated The rich venous supply of these tumors serves as a constant threat of serious hemorrhage so that many clinicians are hesitant even to perform biopsy Radiation therapy and interstitial radium application serve to reduce the size of the mass Surgical removal is accomplished when necessary, and the approaches and methods are discussed This article, however, deals primarily with a case of regression of a nasopharyngeal fibroma. In such tumors, when there is evidence of regression, conservative therapy consisting of androgenic hormones anti anemic measures vitamins, radiation therapy, interstitial radiation and electrocoagulation, has proved most valuable

Schindler, Hurwitz and Greenwood[42] reported a case of teratoid tumor in the nasopharynx of a newborn because it is a rather rare tumor occurring in an unusual location and in an unusually young patient. At the first feeding the infant experienced difficulty in swallowing and became cyanotic. Investigation disclosed a pedunculated tumor attached high in the nasopharynx. This was successfully removed by means of a snare.

MALIGNANT TUMORS

Lederman[43] described the pharynx as extending from the base of the skull to the esophagus, and stated that it is probably one of the largest and most important sphincters of the body It provides a common channel for passage of air and food from the exterior to the respiratory and digestive tracts, respectively There is agreement as to the anatomic subdivisions of the pharynx, but there appears to be little agreement as to the terms used to describe these subdivisions

Lederman gave a summary of the classifications of tumors of the laryngopharynx proposed by some well known authors, which is most interesting but confusing To add further to the confusion the classification used at the Royal Cancer Hospital in London, with which he is associated, was described minutely

There is no question as to its merit, particularly if it were generally accepted

Lederman placed much value on the proper "staging" of tumors of the laryngopharynx, the obvious advantage being that a sound basis is provided for prognosis and for comparing and assessing results of different methods of treatment He proposed three possible ways in which laryngopharyngeal tumors can be "staged" A single method to cover all groups is described and adequately illustrated About 417 cases of laryngopharyngeal tumors, seen over a period of 20 years, were reviewed from the standpoint of chief clinical features and salient points in the history Teleradium treatment was used when possible, and the survival rate was 19 per cent for three years and 13 per cent for five years This is an excellent article which represents a great deal of research and is well worth the time of all interested in these types of tumors

Epstein[44] reminds us that nasopharyngeal tumors usually occur as epidermoid or undifferentiated carcinomas, lymphoepitheliomas or lymphosarcomas Nasopharyngeal tumors are slow in producing discomfort and usually are manifested by nasal obstruction, bleeding, impaired hearing, localized pain and metastasis to the cervical lymph nodes

Epstein reported a case of nasopharyngeal fibrosarcoma in a patient who had no nasal symptoms and no cervical lymph nodes The clinical picture was one of a posterior fossa tumor with no evidence of increased intracranial pressure There was impairment of the third, fourth, fifth, sixth, seventh, eighth and probably twelfth cranial nerves Ventriculography indicated invasion of the right cerebellopontine angle Necropsy disclosed a completely unsuspected tumor of the posterior wall of the nasopharynx which had perforated in the dorsum sella, the clivus and the overlying dura The tumor perforated the basi-occiput and extended as a large encapsulated intradural mass to the right cerebellopontine angle It produced a clinical picture of an atypical mass in the posterior fossa and a roentgenologic picture of an angle tumor without any visible changes in the bone

In an excellent article discussing malignancies of the pharynx, larynx and cervical esophagus, Hilger and associates[45] stated that carcinoma of the hypopharynx has the least favorable outlook for permanent cure Hypopharyngeal carcinomas present real problems and are best managed by performing pharyngectomy in conjunction with neck dissection In certain extensive cases skin flaps and tubes are utilized in second procedures to re-establish normal function Such procedures offer much higher hopes of cure than does radiation.

In an interesting article discussing sex difference in prognosis following radiotherapy for carcinoma of the pharynx Russell[46] reported 550 cases with a ten-year survival evaluation His analysis shows that results of radiotherapy in females are much better and the postoperative mortality rate, recurrence rate, and incidence of secondary involvement of lymph nodes are lower than in males He further found that in all directions explored the same trend emerged in support of the thesis that response to treatment is much better in women than in men.

Antoniazzi and coworkers[47] concluded from a study of the problem of radiation treatment of secondary malignant cervical lymph node metastases from carcinoma of the pharynx that radiation therapy is successful in the metastatic glands if the tumors are radiosensitive They prefer radical surgical treatment whenever possible They pointed out that sterilization of cancer cells is not always achieved even when high doses of radiation are given. The fact that palpable glands persist following radiation does not always mean that metastasis persists This can be proved only by biopsy Radical surgical treatment is usually possible after high dosage radiation, providing therapy has been carefully carried out and the operation performed a short time after termination of radiotherapy

Knowles and Huggill[48] discussed the origin classification and microscopic appearance of liposarcomas The commonest sites of origin are the lower limb, gluteal region and retroperitoneal tissues Their origin in the head and neck is less common These authors doubt that any of the previously reported cases in children actually represented true liposarcomas

They reported a case in the right side of the neck in a 12-

year-old boy Despite two courses of penicillin, the tumor slowly but steadily enlarged and soon produced fullness in the right posterolateral pharyngeal wall Biopsies from both sites proved the diagnosis The lesion did not respond to radiotherapy Metastasis occurred through the blood stream, and the child died exactly one year after the first symptom Postmortem examination revealed an ill-defined tumor of the neck, with such extensive involvement of the soft tissues of the neck as to make determination of the site of origin impossible In addition, there was metastasis to lungs, liver, brain and the middle ear

A sarcoma arising in adipose tissue is not necessarily a liposarcoma Conversely, a clearly recognizable liposarcoma has not necessarily arisen from either mature or immature fat cells There is no general agreement on the origin or microscopic appearance of lipoblasts The obscurities in the knowledge of the origin, development and varieties of adipose tissue are clearly shown in the attempts to diagnose and distinguish different types of liposarcoma A diagnosis of liposarcoma can be definitely established only by the observation of a complete range of intermediate forms between undifferentiated sarcoma cells and well developed fat cells of either the uniglobular or the multiglobular type

Asherson[49] reported a case of postcricoid carcinoma in which the pharynx was reconstructed by using the mucous lining of the larynx and trachea to form the anterior wall of the esophagus This was done in one stage, and although a fistula formed, the duration of hospitalization was greatly reduced compared to the two stage operation

Jernstrom[50] stated that synovial sarcomas are rare, highly specialized, histologically unique malignant neoplasms of mesothelial origin A survey of the literature failed to disclose a previously published case of synovial sarcoma located in the pharynx Such a case is reported in a 21-year-old man who complained of a mass in his throat, followed by gradual development of dyspnea and dysphagia This mass was firm and unattached to the mucosa but fixed to structures deep in the left hypopharynx The precise source of the tumor was uncertain, even at autopsy Comment was made on resemblance of synovial sarcoma and hemangio-endothelioma This article contains excellent microphotographs Jernstrom called attention to two sharply contrasted types of tissue seen in the histologic picture One shows synovial structures and the other fibromatous elements similar to fibrosarcoma These two components are inextricably commingled

Miller and Davis[61] presented a case of primary squamous carcinoma of the hypopharynx with metastases, associated with acanthosis nigricans of the skin, because they were unable to find a similar case in the literature Acanthosis nigricans is usually associated with adenocarcinoma rather than squamous carcinoma, as in the case presented The patient had had a known squamous carcinoma in the hypopharynx for five years before the acanthosis nigricans developed The important clinical features of this disease are discussed

In a discussion of the surgical treatment of carcinoma of the hypopharynx Raven[62] stressed the importance of assessment of operability in each case After discussing the various types of cases he described the radical technique which he employs in the management of carcinoma of the larynx, hypopharynx and esophagus These structures, together with the regional lymph nodes are removed in a monoblock operation This is an excellent, well illustrated article plagued, however, with excessive use of the pronoun I

Tsukamoto and Tazaki[63] sounded a warning against excessive use of irradiation They reported four cases of hypopharyngeal carcinoma which developed 20 years after these patients had received extensive irradiation to the cervical region for tuberculous lymphadenitis It is of further interest to note that carcinoma of the hypopharynx occurred more frequently in females

According to Hara,[64] malignant tumors of the nasopharynx constitute from one to three per cent of all malignancies in this country, eight per cent in Great Britain and 18 per cent in Hong Kong The Chinese, particularly those from the southern province of China, have shown strong susceptibility Hara reported 83 cases of nasopharyngeal malignancies, squamous cell carcinoma being the most frequent type. Because of the diversified pattern of the initial symptoms, the primary site of the growth often remains undetected until development of secondary lesions in the adjacent structures, occurrence of metastasis, or mechanical obstruction

Irradiation is considered the treatment of choice for carcinomas and sarcomas, if there is no osseous involvement, nearly 40 per cent salvage can be expected, whereas when bone is involved the salvage rate is reduced to 10 per cent Surgical extirpation in conjunction with radiation is advocated in cases of fibrosarcoma, adenocarcinoma and sometimes lymphoma

Hara described, illustrated and used a transpalatine approach, which is adequate for surgical removal of the tumor, and he expressed gratification with results obtained The illustrations accompanying this article and the description of the surgical approach should be studied by all interested in these intriguing problems It is interesting to note that in our experience, lymphosarcomas have predominated, and our records show that response to radiation has been encouraging

Kaplan[55] expressed the belief that treatment of cancer of the mouth with cervical metastasis, or cancer of the mouth which is radioresistant, by commando or modified commando procedure will increase the salvage perhaps 30 per cent, and provide amelioration in many uncontrolled cases

In a discussion of the treatment of pharyngeal cancer by a number of participants, Morfit[56] stated that the change by his group to surgical treatment in preference to radiation therapy appears justified on the basis of the unanimously poor results achieved by radiation over the past 40 years According to Hayes Martin the cure rate at Memorial Hospital has more than doubled (30 per cent) following change from radiation to radical surgical therapy

The operation employed by Morfit consists of radical neck dissection with sacrifice of the larynx and a portion of the pharyngeal wall or base of the tongue Since cancer of the hypopharynx occurs mostly among patients in the middle and later decades of life, the occurrence of associated diseases such as diabetes, hypertension and cardiovascular conditions, may be expected in a significant number of patients None of these complications, however, is considered a contraindication to operation

Baclesse[34] stressed the value of radiographic localization of tumors of the rhinopharynx. Specialized radiographic techniques make possible more exact classification of the different varieties of tumors, and in many instances the extent of spread of the tumor can be determined This information is useful in selecting the method of treatment and in determining prognosis

LeRoux Robert and Ennuyer[35] discussed the "en sandwich" technique of treatment of tumors of the hypopharynx This method consists of initial radiation, surgical extirpation and further radiation The authors stated that the "en sandwich" technique is used in cases in which the primary tumor is too extensive for immediate operation when there is severe adenopathy, and in patients with far advanced disease

Vieira[36] reported results of intensive radiation therapy in 31 patients with nasopharyngeal cancer Six additional patients received no treatment because of the advanced stage of the disease Five of the 31 patients treated or 16 per cent, survived five years without symptoms

Towson[37] correctly warned that any tumor found in the nasopharynx should be suspected of being malignant until proved otherwise He reported a case of reticulum cell lymphosarcoma of the nasopharynx The initial symptom was blockage of the nasal passages The tumor disappeared completely following irradiation, and six years later the patient succumbed to coronary thrombosis

Horwitz and coauthors[38] emphasized the fact that irradiation therapy of carcinoma of the hypopharynx has not proved successful in the past. The recent advances in medicine and the vast improvement in preoperative care of the patient now permit surgical attack of carcinoma of the hypopharynx with promise of a much higher percentage of five year cures Unilateral or bilateral neck dissection in continuity with laryngopharyngectomy, although radical, is nevertheless life saving

The authors pointed out that early surgical action, when possible, offers the greatest chance for survival It is pleasing to note that a plea is made for early rehabilitation of those patients who have had extensive and mutilating surgical procedures Too often this important phase of therapy is sadly neglected or even ignored

The high incidence of nasopharyngeal carcinomas occurring in Chinese (18 per cent of all cancer cases) prompted an investigation by Das and associates[59] in an effort to determine whether this disease had a predilection for Orientals Their study extended over a period of three years They were able to show definitely that the incidence of nasopharyngeal carcinoma in India is about 1 7 per cent of all cases of cancer This corresponds favorably with figures from American hospitals

They then concluded that the disease has no predilection for Orientals Emphasis is placed on diagnostic difficulties, and the fact that early symptoms are seldom present. Sixty per cent of the 16 patients studied had cervical metastasis It was concluded that roentgentherapy offered the best chance for survival, particularly if the case was an early one Headaches and bloody expectoration were probably the most frequent symptoms Because of inaccessibility of the region involved, and the absence of pain in the early stages, diagnosis is delayed

Kiem[60] expressed the opinion that carcinoma of the vallecula makes its presence known early because of early discomfort and pain produced by the lesion Early lesions are at times difficult to diagnose, as the variation in the structure of the epiglottis and the base of the tongue is such as to make visualization of the vallecula difficult. Although Kiem stated that he has seen 342 cases of carcinoma of the vallecula, he reported only two cases and stated that in 64 (18 7 per cent) the vallecula could not be seen easily In such cases, displacing the tip of the epiglottis backwards is necessary in order to see the vallecula and obtain a biopsy Preference is expressed for the anterior pharyngotomy route, which consists of an incision at the level of the hyoid bone The technique is well described, and satisfaction is expressed with the results obtained

Mekie and Lawley practicing in Singapore are enviably located to study nasopharyngeal carcinoma. They stated that nasopharyngeal carcinoma is the third commonest type of carcinoma seen in Singapore, and the second commonest seen in Hong Kong. They made a clinical study of 120 cases of nasopharyngeal carcinoma encountered from 1947 to 1953. Their conclusions are in agreement with those of others that males are affected three times as often as females and the initial complaint is most commonly enlargement of the cervical lymph nodes however among the main symptoms of their patients were the usual ones, such as epistaxis, nasal obstruction, headache and deafness.

In 45 per cent of the patients the cranial nerve was involved, the most frequent being the sixth nerve. Radiologic evidence of destruction of cranial bone by the tumor was evident in a fairly large group of cases, and erosion of the floor of the middle cranial fossa and the sella turcica, and opacity of the sphenoid were common signs of intracranial involvement Mekie and Lawley plan to publish other reports based on this study With the environment enjoyed careful analysis and scientific observation should make these future reports valuable.

Batory[42] emphasized the fact that lymphoepithelioma of the nasopharynx is not only uncommonly encountered in childhood, but it is difficult to diagnose in its early stages if adenoids are still present. She reported such a case occurring in a five-year-old child whose first symptom was cervical adenopathy These enlarged glands were first thought to be secondary to enlarged tonsils, however their continued growth prompted more thorough examination, which disclosed a greyish mass in the nasopharynx. Biopsy soon disclosed the nature of the growth and radiation was instituted

Batory stated that lymphoepitheliomas constitute 16 per cent of tumors of the head and neck in children These tumors are of course found more frequently in adults and the problem of diagnosis is a bit simpler Fortunately, these lesions are of such structure that they are extremely radiosensitive. Extension of the tumors in the nasopharynx will result in involvement of practically all the cranial nerves

Whereas the prognosis is always grave in nasopharyngeal lymphoepitheliomas, good results are frequently obtained with early, thorough radiation

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THE ROLE OF TRANSIENT-INDUCED REVERBERATIONS IN ELECTRO-ACOUSTICAL SPEECH AMPLIFIER SYSTEMS

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INTRODUCTION

In general, the improvement in hearing attained by the hard-of-hearing through the use of electro-acoustical amplifying devices falls considerably short of what might be expected[1] on the basis of restored sound level and frequency response Observation shows this discrepancy to exist, not in the ability of the individual to respond, but in a misunderstanding of the meaning usually assigned to the terms "sound level" and "frequency response", for if the term "sound level" is specified to refer to the level of amplified, but unmodified and uncontaminated, transient sound impulses such as found in speech and music, this discrepancy is reduced or disappears entirely

Frequency response as ordinarily given or measured by continuous sine wave excitation has little or no significance in itself[2] If one specifies that the output of the amplifier must be unmodified, its transient response must be perfect This in turn requires a flat or uniform frequency response over a wide range, not only on sinusoidal sound waves, but also on transient pulses, in addition, when an unmodified output is specified, this qualification requires the power output of the amplifier to be sufficient to assure that linear amplification exists without overloading on instantaneous peaks

Specification of an uncontaminated transient output pulse in turn assures that harmonics are not added by non-linear distortion and that there is no intermodulation distortion Finally, this specification makes certain that no internal reverberation or "ringing" exists

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It is the purpose of this article to suggest that these little-known or little-considered transient properties of speech amplifiers are important, and that poor transient response is probably responsible for many of the difficulties encountered by the hard-of-hearing in the use of such equipment.

It is the further purpose of this article to show that it is possible to provide a system having good transient response, and that it can be determined by measurement whether a good or poor transient response exists

MATERIALS AND METHODS

In the experimental investigations reported in this article a number of representative miniature audio amplifying systems were tested for frequency response, dynamic range, maximum power output and transient response characteristics The reference standard where applicable, was a calibrated miniature condenser microphone system (Altec-Lansing M-11) coupled to a specially constructed ultra high-fidelity amplifier for faithful reproduction of transients[2] Energy spectra were analyzed by means of a General Radio Co wave analyzer (Type 736-A) Visual oscillographic observation of waveforms was maintained during the analyses

THEORETICAL CONSIDERATIONS AND FINDINGS

The difference between distortion and reverberation in amplifiers may be seen in Fig 1 When a square pulse shown at *A* having a time duration of $t_2 - t_1$ and having an amplitude or pulse height h, is altered by passing it through an amplifier system having distortion due only to non linear amplification and poor frequency response, the approximate shape of the emergent pulse is given at *B* Failure of the system to follow rapidly changing amplitude distorts the sharp corners and causes a loss of character

A system having resonance or oscillating tendencies, will not be able to follow a sharp rise in amplitude, but is limited to a rate of change compatible with its natural frequency When excited, the tendency to oscillate may carry the amplitude far beyond the proper maximum, resulting in a series of decaying waves, or a damped wave train, as shown at *C*

It may be observed that the amplified pulse shown at *B* always has less peak amplitude than it should have, while the amplified pulse shown at *C* may attain a peak, or transient pulse, several times as great as it should be The pulse at *B* has lost some of its characteristics The pulse at *C* has gained an additional characteristic, that is, reverberation or unrelated noise

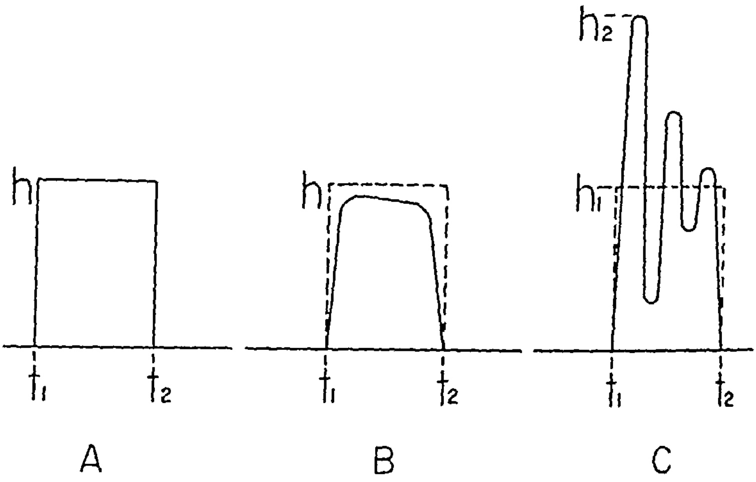

Fig 1 A exciting sound pulse having amplitude h and duration t_1 t_2 B change in pulse after passing through amplifier having distortion C, change in pulse after passing through amplifier having definite resonance or internal reverberation

If the pulse shown at *C* represents the output potential of an amplifier system in volts, and the transient excursion reaches a peak value of h_2 of 3 1 times its average value h_1, the unrelated peak noise background power in the output at that time becomes 10 times greater than the power representing the original exciting impulse Peak power values of 50 times have been observed in actual practice

Reverberation and distortion usually exist simultaneously in a system, each exaggerating the other

There is always an upper limit of power, or sound pressure, which may be safely applied to the ear canal[3] This limitation is usually, and desirably, achieved by saturation or peak clipping somewhere in the amplifier system Reduction of reverberation, by lowering the total peak amplitude of sound pressure present permits the use of a much higher, safe, useful, signal level, with less distortion, and no peak clipping over a wider range of intensities

Any part of an audio system which has individual resonant properties produces a damped wave train upon excitation, and this process is known to audio engineers as "ringing"[2] Actually the result is internally generated echo or reverberation, and as it is very difficult to measure and specify satisfactorily it is not usually done

In order to show the importance of this completely neglected property of hearing aids, an investigation of several typical hearing aid systems was made with regard to their behavior on pulse or transient excitation The method consisted of generating in air a free field single pulse, exposing the hearing aid system to it at a sound pressure level well within the power handling capacity of all units tested, and measuring the energy produced in a proper resistance load at different frequencies by means of a General Radio Co wave analyzer, at different pulse repetition rates. The results cannot be shown well graphically or stated in simple terms because different repetition rates of the same non sinusoidal pulse excite a different series of resonances or internal echoes, and a graph or table of values must be obtained for each repetition rate A tabulation of the behavior of two typical hearing aids systems under ideal conditions is given for one repetition rate in Table I

A free field pulse was monitored in an essentially anechoic chamber by an Altec Lansing BR-150 condenser microphone system and the relative energies in per cent contained in the pulse itself at each of the frequencies in Column I is given in Column II The energy present in the pulse at the fundamental or pulse rate frequency of 360 cycles per second, was taken as 100 per cent.

As might be expected, maximum energy of the pulse exists at a frequency equal to the repetition rate, and the energy existing at any other frequency is, therefore less than that existing at the fundamental frequency The pulse thus an alyzed should not change its energy distribution in passing through an amplifier unless the amplifier has poor transient response, and the amount of change incurred in energy distribution at different frequencies in traversing the amplifier system is an indication of the accuracy of the transient response of the system It must be remembered that this does not evaluate the frequency response of a system *per se*, for only one repetition rate or frequency is introduced

TABLE I

I	II	III	IV	V
Frequency	Energy	System 1	System 2	System 3
360	100	100	100	100
720	27	64	256	64
1080	25	81	900	90
1440	8	25	400	76
1800	13	49	900	72
2160	9	49	900	49
2520	13	100	1089	25
2880	8	169	1156	19
3240	9	324	900	12
3600	10	3360	900	9
3960	8	325	400	6
4320	16	441	576	3
4680	10	196	121	6
5040	25	169	240	13
5400	10	121	56	8

Change in energy frequency distribution of a sharp pulse spectrum as given in Column II occurring when the pulse passes through three different electro-acoustic systems at a repetition rate of 360 pulses per second

Column I gives the frequencies at which the corresponding percentages of relative energies of Column II are found in the original pulse

Column III and Column IV show the changes occurring in the spectrum of Column II after the pulse passes through two typical systems

Column V shows the changes occurring in the spectrum of Column II after the pulse passes through the improved system

Results obtained in this manner and shown in Table I must be interpreted on the basis of the translation of, and addition to, the energies existing in the original introduced pulse at the various frequencies It must also be considered that this is not only a redistribution of energy, but also the addition of energy from internally generated sources, for the redistribution spectrum contains proportionally more energy at some

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The author expresses his appreciation to Armin Graber director of the Hearing Institute of the Colorado Springs Medical Center and William Holmgren of Vicon Inc for their generous effort expended in the construction of equipment and the observation of the data given in Table I frequencies than existed at the original fundamental rate frequency Thus the value of 3360 shown in Column III represents 33 6 times the energy which existed at 360 cycles

Column III shows the redistribution of energy which occurs as the result of reverberation when the pulse having energy distribution shown in Columns I and II is passed through a typical hearing aid system Column IV was taken in the same manner as Column III except for another typical system

Column V gives values as obtained in Columns III and IV, but for an experimental system designed to improve transient response and eliminate or reduce internal reverberation or echo The difference is at once apparent

Table I shows that a transient non-sinusoidal sound pulse may be so altered in traversing an ordinary hearing aid that its final frequency-energy spectrum is completely unrecognizable.

Unfortunately, one cannot say how bad Systems 1 and 2 of Table I are or which one is the better of the two One can see at once that both systems generate large internal unrelated echo, and that in each case the echo becomes several times greater than the pulse which produced it, and that this extra energy represents truly irrelevant sound The internally generated reverberations of System 1 appear to be concentrated in a fairly narrow band sharply centered at 3600 cycles per second

System 2, while not exhibiting an extreme reverberant peak at any one frequency, produces many somewhat smaller peaks spread over a large frequency range, apparently producing a total unrelated noise power far in excess of that of System 1 In contrast, System 3 reproduces the energy spectrum of Column II much more faithfully, and would appear to be relatively free of noise power generated by internal reverberant effects These interpretations of Table I were substantiated by critical listening tests

Reverberations which are highly damped or of short duration may exist only during the time the original pulse exists and so produce an instantaneous background which disappears when the sound transient ends These effects are extremely insidious, for to the listener in an ideal location all is quiet until a sentence is spoken by one individual, at which time it sounds to the listener as though a louder instantaneous background of other noises and sounds exists, which defies detection or location

Reverberations of longer duration are more like echoes and are, therefore, more obvious and, while perhaps less distracting, add to the general noise-to-signal ratio as an increase in unrelated background The effect on the listener is to give the impression of a noisy and unnatural background through frequency translation and the disproportionate addition of energy to the usual small but real background sounds

When strong reverberations exist in a system, saturation or overload and peak clipping occur, not only when the desired sound impulse drives the amplifier to saturation, but also when internally generated background noise amplitude, which is then greater than the desired sound impulse amplitude, saturates the amplifier first It follows then that greater useful power output may be obtained from a given system if power is not wasted in amplification of internal reverberation

GENERAL DISCUSSION

It can be shown by means of a high fidelity audio system that frequency response curves of a system taken without consideration of, or regard to, other dynamic effects have surprisingly little significance when the system is used for the correction of hearing defects Frequency response curves are generally taken by means of sine wave inputs of different frequencies, and by the very nature of harmonic motion and harmonically varying electrical currents there is a tendency for an entire system, including microphone, amplifier, and earphone to behave like a pendulum and follow a sustained sine wave input, so that the output waveform on an oscilloscope may look very good indeed

Most amplifiers measured this way would appear to have a wide and flat frequency response, but if a non-sinusoidal waveform, such as a square wave or single pulse as shown at *A*, Fig 1, is introduced, it would be found that the instrument fails to follow sharp changes in incident or transient waveform, and the result would be a waveform as shown at *C*

Sounds which exist in nature are seldom continuous, but vary over a large dynamic range and wide frequency spectrum, so that normal speech produces instantaneous sound pressures having extremely sharp and transient character For this reason accurate transient response becomes the one most necessary single characteristic of electro-acoustical transducers[3]

One may easily demonstrate by means of an oscilloscope that any transient sound wave of short duration produces within a poorly designed system a damped wave train, which frequently endures for a length of time much greater than the duration of the single initial exciting impulse There will usually be one dominant fundamental frequency excited in this manner, and this is the frequency at which the microphone and earphone will acoustically couple to produce a howl if placed close together

There are also a number of other modes of vibration or resonant frequencies of such a system which are excited whenever the shape of the incident transient waveform is changed.

Each possible resonant frequency which may be excited by a transient sound wave constitutes a separate source of unrelated noise generated within a system A truly aperiodic system having no excitable resonant frequencies at a given sound power output level would, by its very nature, have a flat frequency response over wide limits, but a flat frequency response, particularly over a limited range, when obtained by means of a continuous sinewave generator, does not indicate that excitable resonances do not exist

This lack of relationship becomes readily understandable when one considers that these systems consist of three parts a microphone an amplifier and an earphone It has been customary practice to compensate individually one of these three units against the other two and each against the other so that their resultant behavior produces a relatively flat frequency response as measured in terms of continuous sinewave sound energy Such compensation may not be, and usually is not, effective in producing faithful response on anything but sinusoidal waveforms, which is not the object of accurate speech reproduction

Resonant peaks may exist in a system at a frequency which is above that which can be reproduced by an earphone or above that which may be heard by an individual Resonance, however, at any frequency produces reverberation, and the resulting internally generated wave trains may mix with the complex waveform of the useful sound being amplified, thus adding noise power at sum and difference frequencies, many of which are in the audible range

It is unfortunate that one cannot assign a simple number, or factor of merit, to the transient response or fidelity of a system, so that comparison could easily be made on a scientific basis This cannot be done because the transient response is dependent upon many things and is affected by each in a different way At first it would appear that when we speak of poor transient response, we mean excessive distortion Distortion, however, in electro-acoustical systems usually refers to the production of harmonics of the original impulse and is always related to the original impulse Distortion is but one effect which may enter into transient response, and in general the term distortion should be applied only to the process whereby a sound impulse, in going through the system, is modified and poorly reproduced One may learn to tolerate and even to discriminate accurately in the presence of severe distortion,[3] as one would learn to understand an individual having a severe speech impediment. Distortion is at least related to the waveform which is being distorted

Failure of transient response due to resonant effects in any part of the system is, however, an entirely different matter Resonant effects excited by a transient pulse and temporarily sustained as reverberation within the system may become totally unrelated to successive pulses with which they co-exist and, therefore, cannot be learned or be associated in any way with a given type of sound impulse The effect of such internally generated noise is to increase what might be termed unrelated instantaneous background or, in effect, to produce "masking"[4] Because of the seminatural tonal quality of such unrelated background as opposed to the continuous hiss-type background, it becomes impossible to separate it from the natural sounds to which one is trying to listen

The length of each wave train excited by a transient may be so great that it does not die out between succeeding transient impulses and as each impulse produces or excites wave trains of different fundamental frequencies, these are added vectorially and the result is failure in the ability of the listener to discriminate between small useful and large useless components because of this insidious type of confusion One finds that much of the available power in some systems is wasted in the production of useless and confusing sound

Internal reverberation increases peak instantaneous power and so reduces the useful dynamic range of any system by causing a small signal to ride upon and be amplified with a much larger useless signal, while at the same time causing distortion of the weak signal by putting it on top of the peak of the internally generated but unrelated noise component, where it is most likely to be distorted by any overdriven part of the system or clipped, if peak clipping can occur

There are various reasons why considerable dynamic range is essential The Fletcher-Munson curves[6] show that the intensity or level at which a given shape pressure wave is introduced into the ear canal alters the quality of the sound perceived due to change of sensitivity of the ear to different frequencies at different sound levels There is obviously, only one intensity at which a given sound can be heard naturally in any given ear It also follows that once this correct sound level has been established for one given sound all other sounds will be at the correct or best respective level, unless the electroacoustic system fails to have linear amplitude response and sufficient dynamic range Once properly established there is no theoretical justification for desiring or permitting a change in gain-control setting unless the device has insufficient range

The Harvard report shows that when a high fidelity amplification system is provided, a flat frequency response is usually preferred by the hard of hearing, the only acceptable modification being a 6 db, or less, per octave rise in high frequency response[1,2] One may also expect this result, theoretically, from the fact that only an amplifier having a flat frequency response over a very wide range of frequencies could permit perfect transient response, and the only modification of such an amplifier which would not exhibit discrete resonance would be a continuously sloping characteristic.

Almost any simple method of altering frequency response alters transient response to such a degree that the effects obtained may be attributed more to alteration of transient response than to frequency response

CONCLUSIONS

Measurement of transient induced resonance, or reverberation, in electro-acoustical systems indicates that good transient response is of primary importance in speech amplifiers used by the hard-of-hearing Data measured by means of a wave analyzer are given for several typical systems which show the change or translation of the energy-frequency spectrum that occurs when a sharp repetitive transient pulse of known energy distribution traverses these systems

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THERMAL EFFECTS ON THE TYMPANIC MEMBRANE[*]

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Pittsburgh, Pa

About eight years ago, shortly after assuming the otological consultation responsibilities for a branch of one of the nation's largest steel producing companies, an elderly man came to me complaining of a discharge from his ear On taking his history, I found that 20 years previously he had suffered a burn of the tympanic membrane when he was caught in a shower of sparks during the process of pouring an ingot. The patient very curtly and precisely explained his trouble with, "I got a spark in my ear, Doc." I had no idea how frequently I was to hear this expression and how it was to be the stimulation of my interest in a problem which at the time, I had no idea existed On further questioning this patient, I learned that after the initial injury, he had been troubled with periodic attacks of mucoid or purulent discharge from this ear

He would report to the first aid station and receive treatment for a period finally being sent to the otological consultant for examination and treatment. All this was done on company time, and with hourly wages being paid Examination of the patient showed a central type perforation in the inferior anterior quadrant of the tympanic membrane The margin of the perforation was quite smooth and appeared to have a thick rounded edge The tympanic membrane in the immediate area about the perforation was dull and opaque. At the time of this examination, I had no idea how frequently I was to have the opportunity of seeing the same picture

From this experience, I concluded I would have to have more knowledge of such injuries With a great deal of en

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thusiasm and the smug feeling that comes with the sure knowledge of past experiences, I turned to a review of the medical literature for an answer This enthusiasm and smugness soon turned to a feeling of frustration and helplessness Hours of searching the medical literature proved only that others in the past had not shared my enthusiasm for the problem, or

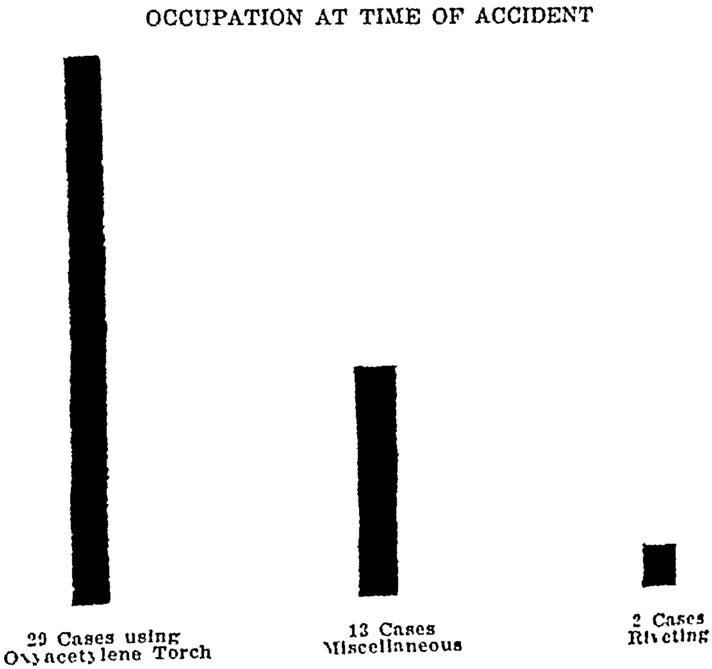


Fig 1

had considered it so inconsequential that it did not deserve recording As time passed, the opportunity to see and observe the progress of spark burns of the tympanic membrane occurred Some definite clinical information was accumulated It is the purpose of this report to record these observations and where possible, attempt a theoretical explanation of these clinical findings There has been no experimental work done, to my knowledge, to prove or disprove these theories

My first impression was that these burns occurred purely by chance, that as workers in the steel industry went about producing steel, they were exposed to sparks or bits of flying molten metal in many steps of the production As experiences accumulated, it became evident that the majority of these burns were occurring among those workers who used the acetylene torch for burning or cutting steel (see Fig 1) This was especially true when they carried out the operation in a cramped or overhead position

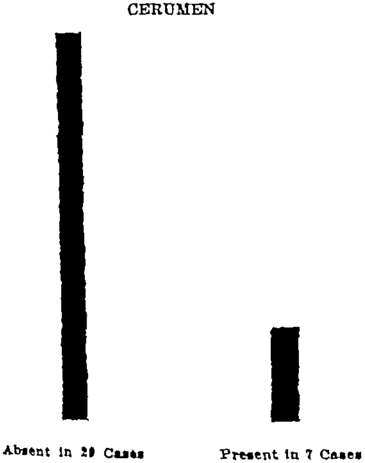
Historically it is interesting to note that Le Chatelier is credited with having discovered the oxyacetylene flame in 1895, and that the first oxyacetylene torches were made in 1900-1901 by Fouche and Picard of France Eugene Bouvnon ville brought the first welding torch to this country in 1906, and since its introduction there has been a continued and expanding use of the oxyacetylene torch in industry The oxyacetylene flame produces the highest flame temperature known to man and is the easiest to regulate In one of the rare mentions in the medical literature on this type of burn, Mosher[1] in 1935 stated "Unemphasized in the medical industrial literature, but becoming an increasingly important industrial hazard among men who do acetylene welding is the entrance of slag into the mastoid region. Loss of hearing has serious psychological and economic reverberations on the person affected Partial or complete deafness may be a serious aftermath of burning of the tympanic membrane by slag

Mosher based his observations on the treatment of 13 patients and pointed out "the majority of these patients suffered injury to the left ear, the right was affected in left-handed workers Intense pain, swelling, and redness of the tympanic membrane are the first symptoms About three days later discharge occurs It is usually profuse and washed out by it are the tiny foreign bodies responsible for the damage After 24 hours the discharge may cease, and the ear remain dry however the slag may remain buried in the mastoid Discharge will then continue spasmodically until all of the foreign body has been expelled Next to prevention in importance, immediate proper treatment is necessary to preserve normal hearing Treatment consists merely of gentle cleaning of the auditory canal once or twice a week Any form of applied medication or irrigation of the ear proves irritating and prolongs the ailment" I quote Mosher's report in detail because it was the basis for the first attempts at treatment, and because my observations, as will be brought out later, differ from his in some respects Papers discussing the problems of health and protection of workers using oxyacetylene, give little attention to the tympanic membrane

Cranch and Vosburgh[2] published a paper in 1942 entitled "Health Aspects of Welding," in which they state "The purpose of this paper is to offer some practical points for the better protection of the health of welding operators", but they do not mention injuries to the ear drum In 1942 the National Safety Council published a Safe Practice Bulletin[3] entitled "Gas Welding and Flame Cutting," in which detailed instructions are given for the care of equipment and operator, but no mention is made of protection for the ear In another bulletin[4] published by the Council entitled "Protective Clothing," the subject is dismissed with "for welders and others whose ears may come in contact with molten metal sparks, ear protectors of wire and felt construction are available" Walsh and Britton[5] mention in their report, "Health Hazards of Electric and Gas Welding," published in 1941 "the occurrence of otitis media following the perforation of the ear drum by molten metal spattered from neighboring welder's work"

Moritz and Henriques[6,7] have made experimental studies of thermal injuries to the skin, and some of their basic findings may well be reviewed to help in explaining some of these clinical observations in burns of the tympanic membrane These investigators reported "the time required to produce irreversible injury bore an inverse relationship to temperature The higher the surface temperature, the steeper the trans-cutaneous gradient becomes and the shorter the time required to destroy the epidermis As surface temperature is increased, the damage to the deeper tissue becomes relatively less severe than to the superficial cells"

They also reported that "the surface color of third-degree burns ranged from pale gray through red, purple and brown to black, depending on certain attributes of the exposure responsible for their production A red, purple, or brown surface, due to the presence of blood in the superficial layers of the skin resulted from exposures in which the dermal temperature was raised slowly enough to permit advanced engorgement of the superficial capillary plexus before the occurrence of coagulation. A gray or ischemic surface indicated that the upper portion of the dermis had undergone thermal coagulation before the superficial capillaries had become fully engorged" They also conclude that "although the quantitative results of a short exposure of high intensity may be similar to those of a long exposure at low intensity, they are likely to be significant qualitative differences between such injuries Hyperthermia of high intensity results in a coagulative type of necrosis in which the dead tissue does not undergo autolysis, resist organization and is usually disposed of by sequestration Hyperthermia of low intensity results in noncoagulative type of necrosis in which the dead tissue undergoes



Eight cases in study not included because the time interval between accident and time of examination was too great.

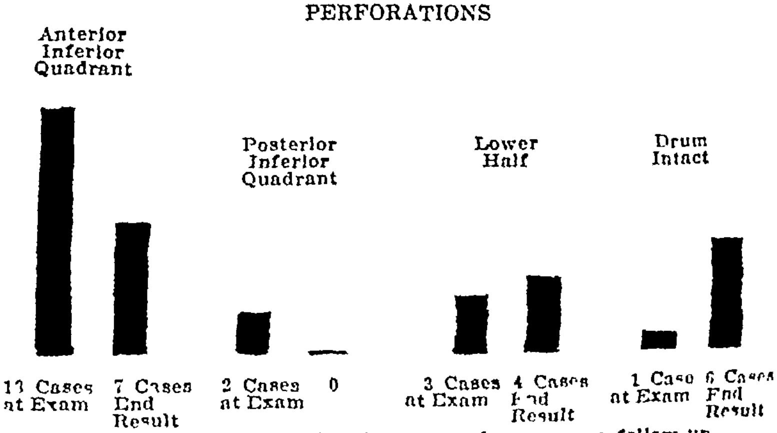
Fig 2.

autolysis and is readily susceptible to organization" It is from these findings that I have attempted to explain the clinical observations made in a series of cases where the tympanic membrane was the recipient of thermal injury

Clinical observations that have been borne out by a series of 44 cases

1 Burns of the tympanic membrane were not observed in cases in which cerumen was present in the external auditory canal (see Fig 2)

2 Perforations do not always occur immediately, but may be delayed for 48 to 72 hours



Two cases were not included because there was no follow up

Fig 3

3 Discharge following a burn, with or without perforation of the drum, may be delayed 48 to 72 hours

4 Prognostication as to the delayed appearance of a perforation of the tympanic membrane can be made by the appearance of the drum

5 A majority of the perforations occur in the inferior anterior quadrant of the tympanic membrane, and are of the central type (see Fig 3)

6 The edge of the perforation resulting from a burn heals rapidly and assumes a smooth rounded appearance

7 Perforations larger than one-eighth (estimated) of the area of the quadrant of the tympanic membrane in which it occurs will not close over Generally perforations resulting from burns are resistant to attempts at encouraging closure

8 The use of antibiotics and a local agent capable of assisting in removal of debris, shortens the time of disability and preserves hearing

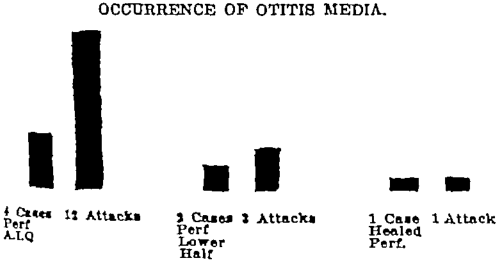


Fig 4

9 The occurrence of repeated attacks of catarrhal or purulent otitis media is common following a burn of the tympanic membrane resulting in a perforation

CERUMEN

There have been no burns of the tympanic membrane noted in those cases in which cerumen could be demonstrated in the external auditory canal Frequently, I have examined work men who report to me because they have had a spark fly in the ear and are concerned that some damage may have occurred to their drum. In none of these cases have I been able to demonstrate any evidence of damage to the tympanic mem brane. Cerumen could be demonstrated in all cases. These men frequently report they heard a sizzling or frying noise in the ear when the spark entered This occurrence is apparently not too uncommon, for on questioning a number of workers using the oxyacetylene torch, they related similar experiences On examination, it was found they had fairly large cerumen deposits in the external auditory canal Apparently the spark is slowed down or stopped when it reaches the cerumen, and the workman's reflex action of shaking his head on feeling the spark enter the ear, allows it to be ejected immediately without damage to the tympanic membrane

DELAYED PERFORATION

Following the entrance of a spark in the ear, examination frequently reveals no evidence of a perforation of the drum in the ensuing 48 to 72 hours Examination after this interval will reveal a well-rounded perforation, with the characteristic thick, rounded edge This may be explained on the basis of Moritz and Henriques[6,7] findings that hyperthermia of high intensity results in a coagulation type of necrosis which resists organization and is usually disposed of by sequestration Sparks may be thought of as miniature fires, consuming the burning material at a terrific speed and having that consumption accelerated by oxygen in the air as they speedily pass through it Their temperature,[8,9] could well range from 1000° to 1500° C Thus the source of hyperthermia of high intensity would be present for a very short interval This impact with the drum is thought to cause immediate coagulation of the blood vessels and results in a necrotic area in the drum, which separates in two to four days, and leaves a round, smooth-edged perforation I have never observed any granulation tissue on the edges of these perforations

AURAL DISCHARGE

Discharge from the ear may be delayed from 48 to 72 hours following the entrance of a spark in the ear This is true with or without a perforation being present This discharge, in the early stages, appears to be of a serous type, and is believed to be due to vascular permeability Moritz and Henriques[6,7] found that "thermal vasodilation characteristically leads to increased vascular permeability and edema formation. The escape of edema fluid at any particular sublevel requires *1* That the vascular injury at that level has been sufficiently severe to result in increased mural permeability, and *2* That it has not resulted in cessation of blood flow through the damaged vessels" It is believed that such changes occur in the tympanic membrane and result in the eventual escape of serum If antibiotics are not used this fluid becomes purulent.

PROGNOSTICATION OF PERFORATION OF THE DRUM

If the opportunity presents itself for seeing a drum in the first 24 hours following a thermal injury one can frequently predict the occurrence of a perforation by the appearance of the drum If the drum has a uniform pink to reddish appearance, it is not likely that a perforation will occur If the drum has a dull yellowish gray appearance, with all evidence of luster lost, one can expect a large perforation in the following 24 to 48 hours In drums where there is the appearance of radiating vessels being congested and seemingly extending from an area brick red to yellowish gray in color (no matter how small the area) a perforation can be expected in that area in the following 24 to 48 hours When the drum appears uniformly pink to red, I feel this is analogous to the erythema seen in the skin with a first-degree burn Frequently, in such instances, a "blushing" is noted in the osseous portion of the external auditory canal

It is believed that the spark is in its last moment of consumption as it enters the canal, and the heat engendered by its burning is present only for a moment before consumption is complete and the source of heat is gone This type of burn will show recovery in 48 to 72 hours with the tympanic membrane assuming a normal appearance. The grayish drum is characteristic of the early stages of necrosis This necrosis is caused when the drum is subjected to intense heat for a short interval, causing coagulation before vasodilatation can occur Perforation occurs in the ensuing 48 to 72 hours, and usually results in a large central type perforation, occupying part of two or more quadrants of the drum. There is apparently a sequestration of the damaged area, and the surrounding tissue goes on to eventually assume a normal appearance The perforation then remains static.

In the drums where radiating engorged vessels are observed extending from an area brick red to yellowish gray in color, one frequently observes a perforation at this focal point in 24 to 72 hours It is believed that such a burn is caused by a very minute spark contacting the drum at this point Coagulation occurs at the point of contact, and then the intense heat is dissipated radially from this point and into the air contained in the middle ear One will occasionally observe these perforations becoming slightly larger in the ensuing 48 hours after their appearance, and then remaining stationary in size

PERFORATION IN THE ANTERIOR INFERIOR QUADRANT

Frequently these perforations occur in the inferior anterior quadrant of the drum, and are always of the central type Heermann[10] also made this observation No marginal perforations have been observed There is no explanation for the frequent occurrence of the perforation in the inferior anterior quadrant, except that the workman's head is tilted upward in such a position as to make a straight line from the point of entrance of the spark to the inferior anterior quadrant of the drum The central type perforation is explained on the basis of the blood supply of the tympanic membrane, although Heermann[10] explains it on the basis of the Leidenfrost phenomena The blood supply enters partly along the long process of the malleus, and partly from the margin of the membrane Because of the better blood supply around the periphery of the drum as compared to the center portion, there is greater opportunity to maintain vascularization and thus prevent necrosis in this area

EDGE OF PERFORATION

The edges of the perforation, resulting from a burn, apparently heal very rapidly and quickly assume a rounded edge This is assumed to occur because of the coagulation and necrosis The blood vessels are destroyed in a given area and the ends sealed off Fibrous tissue quickly covers the edge and leaves a smooth, rounded surface

CLOSURE OF PERFORATIONS

Perforations resulting from burns are resistant to attempts at closure It has been my experience that perforations larger than one-eighth (estimated) of the quadrant involved, will not close spontaneously Perforations smaller than one-eighth of the area frequently close spontaneously, but if they are present for five to six days without evidence of closing, they remain open Attempts at closing the perforations, using trichloracetic acid, have failed I feel that these perforations are difficult to close because we are dealing with a tissue that has a damaged and minimized blood supply The use of acid is believed to add further insult to an already damaged tissue.

TREATMENT

Treatment has been found to be most effective if antibiotics are given systemically early and to full therapeutic dosage When discharge occurs, the use of a local agent such as glycerite of hydrogen peroxide assists in removal of debris In early cases Mosher's[1] suggestion of "gentle cleansing of the auditory canal once or twice a week" was carried out Under this regime infection frequently occurred and the time of discharge was prolonged and hearing was lost. The use of antibiotics locally was tried and the results, although better were not satisfactory It was not until antibiotics were given systemically and a cleansing agent used locally, that satisfactory results were obtained The use of penicillin, 400 000 units intramuscularly daily for five to seven days, is now being used The antibiotic is given intramuscularly so as to be assured the patient gets the medication

Oral medication was tried and proved satisfactory when the workman took it as prescribed, but a goodly number would fail to follow orders so the intramuscular route is now used to insure proper continuity of medication. Glycerite of hydrogen peroxide, 10 to 15 drops, is instilled in the affected ear twice daily It is left in place five to ten minutes following which the head is turned and the medication allowed drain out for three to five minutes Examination is repeated at five to seven-day intervals, in order to allow for observation and adjustments in treatment

During the treatment of the first cases, when the discharge was persistent, I felt I was dealing with a foreign body in the middle ear or mastoid X-ray studies were made, but I was never able to demonstrate any foreign bodies by this method In my experience I have had comparatively few cases in which a foreign body was present and removed In these cases, the foreign material was either in the external auditory canal or adherent to the drum

REPEATED ATTACKS OF OTITIS MEDIA

Because the perforation so frequently occurs in the lower anterior quadrant of the drum, occurrence of catarrhal or purulent otitis media is relatively frequent following such burns It is also observed frequently in perforations occurring elsewhere in the drum There is usually a history of upper respiratory infection, or of getting water in the affected ear I theorize that the mucous membrane of the tympanic cavity is frequently altered by thermal injury, and becomes more susceptible to infection These patients present the classical picture of catarrhal or suppurative otitis media, and are treated in the same manner

PREVENTION

This sequence of events caused by the flying spark pain, discharge, loss of time from work, permanent damage to the ear drum, frequently decreased hearing acuity, could in the writer's mind, be avoided by the simple expedient of covering the ears with a fine-mesh wire guard, fashioned after the old-fashioned tea strainer and held in place like ear muffs When such a device is suggested to workmen, they scoff at the idea and complain that such an apparatus would be cumbersome and interfere with their work Certainly an educational program would be necessary to train them to wear such a protective device, thereby saving themselves from damage to their ears

CONCLUSION

Spark burn of the tympanic membrane is a problem with many facets of interest. The psychological effects on the patient vary from the realm of pure imagination to persistent worri some tinnitus Patients frequently blame the damaged drum for all their future aches and pains, and come to expect their employer to assume the obligation for their medical care This feeling tends to become more marked after the patient has had one or two episodes of purulent discharge from the ear Others are emotionally upset and fear that they will become totally deaf

The employer's side of the problem deals with the costs of treatment, the loss of man hours, and the future obligation to provide medical care if and when an otitis media occurs Both the employer and the employee could be saved this trouble, physical and financial, by the use of some simple means of prevention One wonders if the physical and chemical properties of cerumen hold the answer to a simple protector in the form of a synthetic cerumen that could be applied in the ear canal A means of closing the perforation would be a big adjunct in minimizing much of the psychological and financial part of the problem. Certainly here is a probler that might be answered by the results observed in animal experimentation with theories displaced with facts

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634 Washington Road

MIDWINTER SEMINAR IN OPHTHALMOLOGY AND OTOLARYNGOLOGY

The Tenth Annual University of Florida Midwinter Seminar in Ophthalmology and Otolaryngology will be held at the Sans Souci Hotel, Miami Beach, the week of January 16, 1956 The lectures on Ophthalmology will be presented on January 16, 17 and 18, and those on Otolaryngology, January 19, 20 and 21 A midweek feature will be the Midwinter Convention of the Florida Society of Ophthalmology and Otolaryngology on Wednesday afternoon, January 18, to which all registrants are invited The registrants and their wives may also attend the informal banquet at 8 p m Wednesday The schedule has been changed to provide a maximum time for recreation each afternoon

The Seminar lecturers on Ophthalmology this year are Drs Francis H Adler, Philadelphia, A Gerard DeVoe, New York, Michael J Hogan, San Francisco, C Wilbur Rucker, Rochester, Minn, and A D Ruedmann, Detroit, Mich Those lecturing on Otolaryngology are Drs Frederick A Figi Rochester, Minn, Lewis F Morrison, San Francisco, Charles E Kinney, Cleveland, John R Lindsay, Chicago, and Bernard J McMahon, St Louis

LARYNGOCELE AND LARYNGOPYOCELE

JAMES CHESSEN, M.D ,

and

PATRICK LUTER, MD ,

Denver, Colo

From the first description by Larrey, surgeon to Napoleon's army in 1829 until this report, world literature has contained only 70 to 80 cases of laryngocele, and only two cases of laryngopyocele. H Marshall Taylor in 1944 presented an excellent survey of the cases previously reported in American literature Realizing that our total knowledge concerning such an infrequent lesion can only be increased by individual reports, we submit in addition to a brief resume of the literature, a detailed case report

Of the many papers reviewed in covering American literature on laryngocele, most report the condition to be ' rare ', however since this condition is omitted from the differential diagnosis of tumors of the neck in surgical texts and papers in the general surgical literature one is prone to feel that this condition is being overlooked, not only by those interested in laryngology but by the general surgeon as well

In his monograph published in 1922, Moore gave a detailed anatomical description of the laryngeal ventricle and the sacculus discussed the comparative anatomy of the ventricle and sacculus and classified the diseases of the sacculus ventriculae In brief he points out that the laryngocele develops from the sacculus, an appendiceal structure protruding from the ventricle of the larynx This upward projection from the roof of the ventricle lies between the ventricular band of the larynx and the thyroid cartilage

The saccule is an atavistic structure which shows more highly developed features in monkeys and other anthropods.

Editor's Note This ms. received in the Laryngoscope Office and accepted for publication August 1 1955

Thus, the larynx contains a predisposing sac for the development of a laryngocele reminiscent of the sac of the processus vaginalis testis, which serves as the precursor of inguinal hernias A weakness of the thyroid membrane at the point where it is penetrated by the superior laryngeal nerve and the vessels has been accorded a role in the etiology of laryngocele Since the description of the pathology in this entity by Virchow, all writers agree that the protrusion from the sacculus passes between the perichondrium lining the medial aspect of the thyroid cartilage and the ventricular band Enlargement, then, proceeds to the upper border of the thyroid cartilage where the cyst may then herniate through thyrohyoid membrane and pass into the superficial structures

Conditions giving rise to an increased intraglottic pressure are sometimes implicated as being of secondary etiologic significance Numerous authors mention chronic abuse of the voice, singing, whooping cough, hornblowing, straining at stool, glass blowing, and weight-lifting as contributing factors to the development of herniation of the sacculus

We feel, as McLauren does, that these common everyday factors are a poor explanation for the development of such a rare condition Larrey first described laryngoceles seen in Egyptian priests who performed daily chanting of the Koran from the mosques in Cairo The association of other secondary pathology in the larynx is very important Schall reports a case in which he found laryngocele associated with carcinoma of the larynx Leborgne, a radiologist, quotes the incidence of association of laryngocele and cancer of the larynx as being as high as 10 to 15 percent

From this anatomical explanation of the origin and progressive growth of laryngocele, the following classification is derived

1 Internal—a cystic dilatation of the ventricle in which the sac of mucous membrane lies completely within the larynx This entity is characterized by symptoms of hoarseness, respiratory obstruction, and dyspnea

2 External—characterized by protrusion of the cyst from the sacculus of the ventricle through the thyrohyoid membrane to the superior cornu of the thyroid cartilage. This type presents as a mass in the neck, often enlarging on coughing, and sometimes capable of being emptied by external pressure over the cyst.

3 Mixed—combines the above types to present a cyst protruding into the larynx as well as an external extension into the neck

Case Report—The patient, a 64 year-old white male was admitted to St. Joseph's Hospital Denver in May of 1955 He had a previous history of coronary occlusion He complained of a lump in the left cervical region which had been present for three years progressive hoarseness and marked dyspnea. There was no induration tenderness or pain associated with the mass, which was located just below the angle of the left mandible. The protruding mass had a cystic feel on palpation The patient reported that he had noted no variation in the size of the mass from day-to-day and it could not be emptied by external pressure He had had no drainage or eruption of purulent or foul material into his pharynx at any time

Indirect laryngoscopy revealed marked compromise of the glottis by an edematous mass which bulged inward obscuring the entire left cord and the anterior two-thirds of the right vocal cord Roentgenograms showed a 6 cm fluid air filled mass to the left of the thyroid cartilage. The mass pressed against the hypopharynx on views taken after a barium swallow

An emergency tracheotomy was then performed to provide the patient with an adequate airway It was elected to aspirate the cyst in order to ascertain the character of its contents, but when pierced by a needle it suddenly collapsed Purulent material was noted at the tip of the aspirating needle when it was withdrawn. The collapse of the cystic mass alleviated the patient's symptoms His tracheotomy was decannulated and he returned home asymptomatic except for mild residual hoarseness and pain.

Three weeks later he was admitted to Presbyterian Hospital with a recurrence of his previous symptoms. Dyspnea was marked and a second tracheotomy was done on the third hospital day Indirect laryngoscopy again demonstrated marked blockage of the glottic opening by a mass bulging inward from the left ventricular band Its greatest convexity projected beyond the median line of the glottis completely obscuring the left cord and all but the posterior third of the right cord.

Anterior posterior and lateral views of the cervical region showed a light tumor 6 to 7 cm. in diameter located in the left side of the neck at the level of the hyoid bone. The lesion contained air and showed a distinct fluid level. Films of the upper esophagus with barium administered by mouth showed evidence of an extrinsic pressure defect in the hypopharynx but failed to reveal any communication between the esophagus and the cystic mass. No planography was done on this case although it has been reported as an excellent means for visualizing the form and relationship of an laryngocele.

The day following the second tracheotomy the patient was taken to surgery Under general endotracheal anesthesia an 8 cm. transverse incision was made over the mass. The platysma and deep fascia were incised exposing a 6 cm. cystic mass which lay beneath the thinned out strap muscles posterior to the omohyoid and anterior to the sterno-

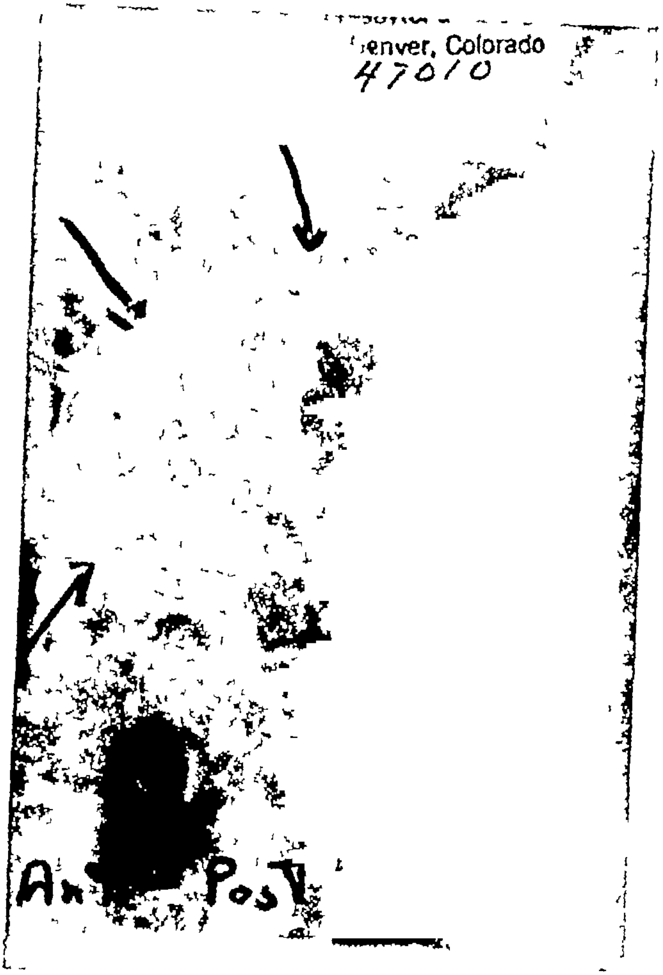


Fig 1 X-ray Examination 7 cm diameter soft tissue mass with air fluid level left cervical area above level of vocal cords causing moderate posterior and right lateral pressure defect and deviation on hypopharynx. Incidental finding—Degenerative narrowing 4th 5th and 6th cervical interspaces with osteoarthritic lipping at these narrowed interspaces posteriorly

cleidomastoid muscle The pedicle of this cyst passed by a narrow stalk through the thyrohyoid membrane and downward along the inner aspect of the thyroid cartilage to enter the ventricle of the larynx by a three by six mm opening The stalk was excised and the stump closed by a purse-string suture of chromic catgut reinforced by two interrupted cat gut sutures The posterior wall of the cyst was tightly adherent to the pharynx by inflammatory reaction

In following a plane of dissection between the cyst wall and the pharynx the cyst was inadvertently opened, spilling 40 to 60 cc of purulent material into the operative field Simultaneously the pharynx was accidentally

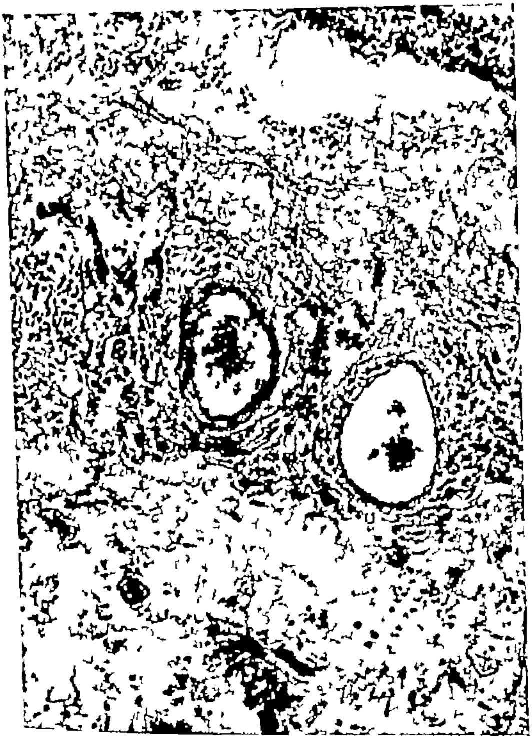
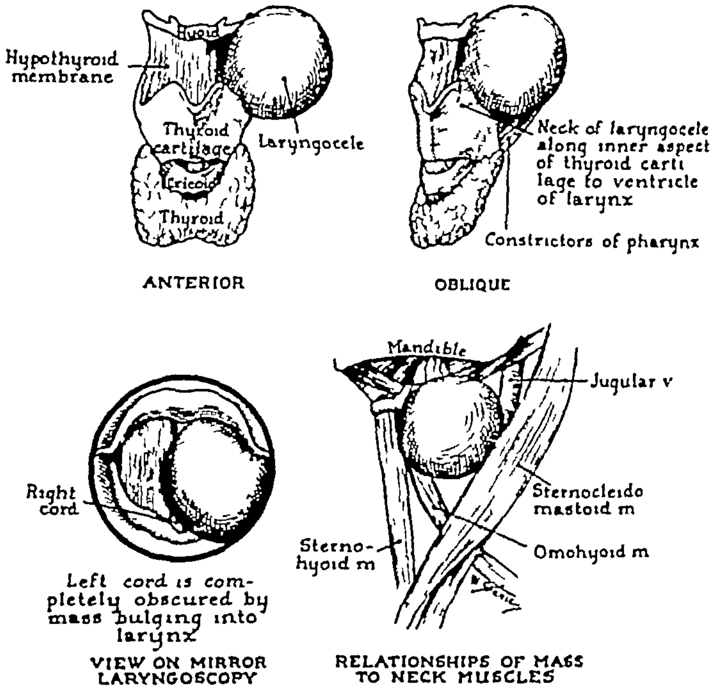


Fig 2. Macroscopic and microscopic description in text

opened and promptly closed with interrupted chromic catgut sutures Cervical fascia was also approximated over the pharyngeal closure for added reinforcement The deep cervical spaces were then drained with three Penrose tissue drains and the neck closed in layers with interrupted sutures. A culture of the cyst contents failed to show any growth after three days

The patient's postoperative course was uneventful with no evidence of deep cervical space infection. The patient received parenteral tetracycline and penicillin for six days following his surgery Feedings were administered by means of a small polyethylene tube for three days then the patient was increased from fluids by mouth to a soft diet in progressive stages

On the ninth postoperative day indirect laryngoscopy showed some residual edema of the left false cord but otherwise the larynx was normal, presenting an excellent airway The tracheotomy was removed following the examination of the larynx, and the patient was discharged on the eleventh postoperative day It was noted at this time that the patient's voice was a little coarse but otherwise normal



ANTERIOR

OBLIQUE

VIEW ON MIRROR LARYNGOSCOPY

RELATIONSHIPS OF MASS TO NECK MUSCLES

FIG 3

The pathological report, made by Dr Alexis Lubchenco follows

'Macroscopic—this is a sac like structure presenting an opening 2 5 cm in diameter and is 4 to 5 cm long presenting an apparent perforation on the fundus The wall of this cystic structure averages 5 mm in thickness The lining is somewhat trabeculated including in some areas velvety mucosa type structures The greater portion appears to be ulcerated

'Microscopic—sections reveal a relatively thick wall of loose fatty fibro-connective tissue heavily infiltrated with granulocytes and round cells, including in some areas prominent microabscesses Epithelium of the cyst is largely denuded, however there are patchy areas in which ciliated columnar epithelium can be demonstrated Cancerous change is

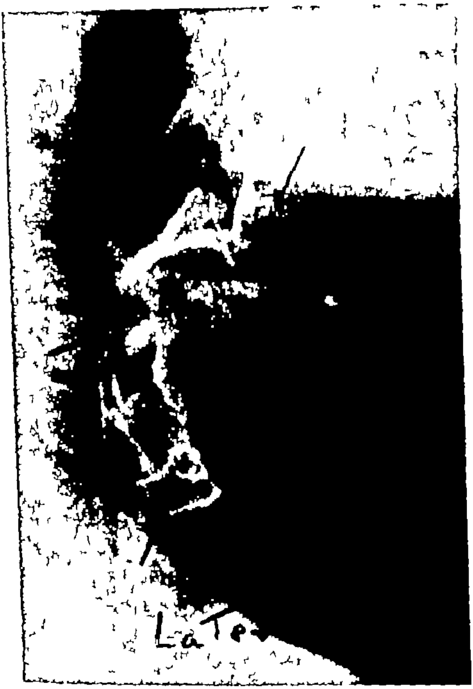


Fig 4

not demonstrated in any of our sections nor is there evidence of specific type of inflammatory reaction In some portions of the cyst skeletal muscle fibers can be demonstrated

"Diagnosis—laryngocele showing extensive subacute suppurative inflammatory reaction"

We feel that this case, under the classification described, represents a mixed type laryngopyocele Secondary infection of the cyst produced granulation, damming back secretions in the sac in a valve-like manner at the point of exit from the ventricle This mechanism of formation of pyocele has been described by Freedman In some cases when pyocele develops, the patient, on coughing, may expectorate pus, although this was not seen in our case Jackson and Jackson in their text state that they have seen only two cases of external laryngocele, but no cases of laryngopyocele

Summary A case of laryngopyocele is reported and the pertinent literature briefly discussed

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1829 High St

VENTRILOQUISM—AN AREA FOR RESEARCH

FRANK KODMAN, JR., Ph.D,
Lexington, Ky

Ventriloquism, a unique phonatory and articulatory phenomenon should be of particular interest to specialists who concern themselves with the vocal and perceptive mechanisms It is the purpose of this article to comment on some information pertaining to this subject with the hope of stimulating definitive research. Experimentation in this area has been almost exclusively European

Huizinga[1] claims that an early record concerning ventriloquism dates back to 2000 B C Luchsinger[2] mentions a Biblical reference to ventriloquism Tarneaud[3] points out that ventriloquists often played the role of "comedians" or court jesters during the Middle Ages

In the way of research, Huizinga[4] cites an investigation by a Frenchman, the Abbè de la Chapelle. This study, in 1772, was among the first serious attempts to examine this phenomenon Merkel[5] discusses briefly the articulatory and breathing movements occurring during ventriloquism

Flateau and Gutzmann, 1894, cited by Huizinga[6], published a monograph after systematically observing six ventriloquist subjects The authors examined the physiological hypotheses proposed by the subjects in the form of introspections.

Thirty-one years later Panconcelli-Calzia[7] published the results of his investigations using a professional ventriloquist He made X ray observations of the vocal mechanism phonating vowels and also recorded the respiratory movements by kymograph using the Gurtel pneumograph

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ORIGIN OF PHONATION

One of the earliest hypotheses concerning the manner of vocal production was that the ventriloquist spoke on inhalation Another theory was that the ventriloquist's voice came from the stomach Among the later studies there is unanimity of agreement that the phonation is laryngeal in origin

THE BREATHING MECHANISM

Huizinga offers a tentative explanation for the misconceptions centered around the origin of phonation He points to the observation that the ventriloquist uses a powerful inspiration of air with the diaphragm depressed and in a low "fixed" position The abdomen is distended forcibly during the entire phonatory period The thorax is also expanded and sinks only slightly during phonation Between extended phonations the thorax is re-expanded to allow new intakes of air

The ventriloquist is supposed to speak almost continually from one maximum inspiratory position of the thorax X-ray examination showed that the air came from the trachea and not from the stomach or esophagus, as in esophageal speech Luchsinger and Tarneaud are in agreement that following the large inspiratory effort, the air is expelled in a particularly "slow" manner

This view is explained by Panconcelli-Calzia, Merkel and Luchsinger, who theorize that following the maximum inspiratory effort, a steady contraction of the muscles of the thorax and abdomen is maintained This steady contraction is supposed to permit greater force on the vocal folds

There is a decreased amplitude in the excursions of the thorax and abdomen during ventriloquistic phonation, as shown by pneumographic recordings A slight swelling in the circumference of the neck is also noted The sub-glottal air is compressed by a constriction produced by the strong contraction of the entrance to the larynx The information on these points is rather vague and incomplete

VARIATION IN THE VOCAL MECHANISM

Several functional variations in the breathing mechanism have already been cited The authors agree generally that there is a constriction of the air passage in the laryngeal, pharyngeal or buccal regions This constriction is mentioned as somewhat analogous to that in deglutition or in vomiting

The lip movements are greatly diminished and a small, fairly constant mouth opening is maintained The position of the lower mandible is held fairly rigid The ventriloquist often speaks out of the corner of his mouth The tongue is said to occupy a middle position and is displaced laterally only slightly The naso-pharyngeal opening is found mostly enlarged The tongue pulls backward and exerts pressure on the hyoid

The pharyngeal cavity is constricted and its volume diminished The posterior position of the tongue plus the upward movement of the larynx further reduces the volume of the pharyngeal cavity

The epiglottis inclines over the ostium laryngis The ary-epiglottic folds are contracted The larynx rises toward the base of the tongue with some posterior movement. The greater cornu of the hyoid approaches the posterior pharyngeal wall The cartilaginous glottis exhibits a strong closure.

The organs of phonation give the impression of considerable muscular tension The bucco pharynx, according to Tarneaud, is used as a "fixed" resonator with a small orifice Its volume is influenced by the position of the larynx vertically In a Helmholtz-type resonator it is known that aperture size and volume are causally related and affect its resonant frequency Mouth opening may thus be compensated for by alterations in the volume of the resonating cavities. Undoubtedly, this is an oversimplification of even one of the dynamics in ventriloquist resonation

ARTICULATION AND PHONATION

Luchsinger and Huizinga found that the ventriloquist's voice was *higher in pitch* (fundamental frequency in cps) than the normal voice The latter determined the pitch range of his subject and found it to comprise about an octave The details of this procedure were not entirely clear

Tarneaud states that a large percentage of the consonants are formed between the back of the tongue and the palate Huizinga found a systematic substitute for the labial sounds The "m" is replaced by "n", "p" by "th" and "b" by "d" Diplomat might therefore be pronounced as *dithlonat* These substitutions are supposed to escape the listener who is concentrating on the "tricks" of the ventriloquist Flateau and Gutzmann described one of their subjects as being able to produce the labial sounds by applying his lips against his upper teeth

Sir Paget[6] describes the articulation of "p", "b", "m", "f" and "v" during ventriloquism The lips are immovable and slightly apart The teeth are separated so that the tip of the tongue can be inserted between them so as to close the space

The performer produces the bilabial sounds by protruding or withdrawing his tongue tip between and behind the inner surfaces of the lips The "f" and "v" are produced by a partial closure of the space between the lips The tongue is pressed against the inside of the lower lip just clear of the upper lip

In general, the vowels are considered to be phonated distinctly although not phonetically pure Huizinga made a comparative physiological study of the vowels phonated normally and then in ventriloquist's voice He compared the vocal structures by means of lateral X-ray photographs The differences attributed to ventriloquism centered largely around the reduced pharyngeal area

VOICE QUALITY

Numerous adjectives have been used to describe the quality of the ventriloquist's voice These labels have little or no validity Due to the extreme muscular tension of the vocal organs, the voice has been labeled by Tarneaud as an "excessively strong pressed voice"

Due to the reduced volumes of the air passages the quality has been described as "compressed" "dampened" and well

evidence is vague and incomplete The application of modern research tools should be applied to point up the quantitative differences in voice and articulation between normal phonation and ventriloquism

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TRANSACTIONS

OF THE

AMERICAN LARYNGOLOGICAL ASSOCIATION

(Scientific Sessions)*

SEVENTY SIXTH ANNUAL MEETING

MARCH 13 14, 1955

HOLLYWOOD BEACH FLORIDA

DR. HENRY B ORTON President

*Abstracted by SAMUEL SALINGER M D., Palm Springs California.

(Continued from October Issue.)

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GENERAL TONSILLECTOMY SUGGESTIONS FOR MANAGEMENT AND PERITONSILLAR INJECTIONS

PAUL M MOORE, M D

Moore reviewed the subject of tonsillectomy under general anesthesia, laying emphasis on the value of injecting the peritonsillar area with a saline solution containing adrenalin, 6 minims to the ounce, which not only facilitates the dissection but also markedly reduces the bleeding He described the preoperative management of the child with the object of minimizing psychic schock. Up to the age of 14 atropine is administered in adequate dosage older individuals are given a barbiturate. Efocaine for the reduction of postoperative pain has proven hazardous and has been discarded He has found that the preoperative use of Cortisone or hydrocortisone is of value in the "thymicolymphatic" type of child. Also the intravenous administration of hydrocortisone has been shown to be effective in combating the hypotension of surgical shock. The operation is performed in the head low position using the Davis gag with attached tongue blade.

DISCUSSION

DR. THOMAS C GALLOWAY cited statistics from the Evanston Hospital showing a decrease in tonsillectomies from 1000 in 1945 to 400 in 1953 This reveals a trend to re-evaluation of the indications. Regarding the relationship of tonsillectomy to the incidence of polio he feels that despite conflicting theories tending mostly to show a predisposition on the part of the former to the latter that the theory of a barrier being removed is not compatible with present theories of the pathogenesis of polio X ray irradiation is again beginning to gain favor if properly administered by an experienced roentgenologist. Rhodes recent paper showing the incidence of bacteremia following tonsillectomy is very impressive particularly since it revealed a lower incidence in cases done by the Sluder or Beck method, the incidence being proportional to the time consumed in the operation

Dr Harkins reported a lowered incidence of bleeding during and after surgery, which he attributes to the routine use of vitamins K and C before, during and following the operation, also he believes good results can be obtained from the use of adrenosan 5 mg IM immediately after the operation

Dr Moore in closing, commented on an editorial in the Journal A M A which stated that a tonsillectomy performed at any previous period of time rendered the subject more susceptible to polio This seems to overlook the simple fact that surgical repair or normal healing, far from removing a normal barrier to infection, offers a natural obstacle Regarding the use of the vitamins he is convinced that they are of great value Certainly children receiving aspirin will show a low prothrombin As for adrenosan, his experience with it in a few cases of nasal hemorrhage has not been convincing He has not tried it in the tonsil cases

◆

CARCINOMA OF MAXILLARY SINUS IN YOUTH

Bernard J McMahon, M D

Because it is very unusual to encounter a carcinoma of the antrum at the age of 20, Dr McMahon presented such a case with a discussion of the therapy The first symptoms were numbness of the cheek followed by swelling and some displacement of the bulb X-rays indicated pathology in the antrum and ethmoids and the sinus was opened on the assumption that a suppurative process was present with involvement of the orbit, however, the histologic examination of tissue removed showed a carcinoma which appeared to be of the radiosensitive type Surgery was not advised because of the extent of the growth and the patient was given irradiation therapy There was considerable improvement locally but metastases, first in the neck and then more widespread proved to be beyond the hope of a cure by any means and the patient succumbed in a very short time Dr McMahon cited Prof Ohngren to the effect that the general impression that metastases occur later is erroneous The rich network of lymphatics in the mucosa of the antrum communicate freely with the larger trunks in the neck leading to the glands

DISCUSSION

Dr Andrew Eggston has noted changes in the classification of tumors based on studies of histogenesis since World War II The slides shown by Dr McMahon are most likely squamous cell type The anaplastic cells take on peculiar behaviors often undergoing metaplasia This accounts for differences of opinion as to nomenclature depending on who sees the slide and what portion of it impresses them Apparently more malignancies are being observed in younger individuals than formerly Recently a case in a child aged 5 originally diagnosed as fibrosarcoma of the sphenoid or ethmoid was later pronounced a neuroblastoma when studied by several pathologists Despite radiation therapy the child developed metastases and died Two other cases of neuroblastoma were seen by Dr Eggston one in a boy of 12 and the other in a woman of 4[illegible] Whether this is a new type of tumor or a reclassification of an old one is not certain yet the fact remains that they are anaplastic and highly malignant Another problem that is perplexing is the increased incidence of so-called papillary sinusitis. These were thought to be akin to recurring papillomata of the larynx often attributed to a virus but in some cases after a long time a recurrence will appear with every indication of malignancy

Dr. Frederick T Hill also has recognized increasing frequency of malignancy in the young. He has been impressed by the symptom of numbness of the face which is highly significant in early diagnosis He inquired whether Dr McMahon had found X ray evidence of involvement of the canine convexity or orbital plate Frequently stereoscopic views will bring out early changes

Dr. Leroy A Schall agreed that the symptoms of numbness of the cheek is a very important one Other symptoms which have impressed themselves are unilateral nasal obstruction recurring hemorrhage exophthalmos pain in the teeth and impaired vision An analysis of 212 cases by the speaker revealed the majority to be carcinomas yet only two were in children although rhabdomyosarcomas and other types of sarcoma were also found Dr Schall recalled several other cases in which the symptoms mentioned above were helpful in the diagnosis and supported by good X-ray pictures The essence of the thing is that one should always be cancer conscious and study these cases carefully in their early stages.

Dr. C E Munoz MacCormick (Porto Rico) reported a case in a child of four with pain and swelling of the cheek where the X rays showed merely a ballooning of the walls of the sinus Surgical exposure revealed a highly malignant mass which had eroded the bony walls even into the pterygo-maxillary fossa.

Dr. Pierce Theobald reported a case in a 48-year-old enlisted man whose early symptom was nasal obstruction It was treated as a sinusitis for some time before a mass appeared in the nose which on biopsy revealed an anaplastic malignancy X rays showed extensive involvement of the sinuses which was confirmed by surgery Apparently it was too widespread to be completely removed and the outcome was inevitable

Dr. McMahon in closing stated that the X rays were carefully studied in his cases, and the contour of the canine fossa and orbital plate appeared unchanged.

The symptoms mentioned by Dr Schall are all very important and he agreed that numbness of the cheek is particularly significant.

◆

FUNCTIONAL DISTURBANCES OF THE UPPER SWALLOWING MECHANISM

John R Lindsay, M D

Functional disturbances of the swallowing mechanism may be divided into three groups those affecting musculature innervation and psychic control Among the first named are such conditions as myasthenia gravis generalized scleroderma, dermatomyositis and systemic conditions such as tuberculosis, thyrotoxicosis and senility These may be demonstrated in the barium test when the fluid tends to remain in the valleculae after swallowing Neurologic conditions affecting the swallowing function comprise peripheral neuritis jugular foramen syndrome, intracranial lesions affecting the nerves and lesions pressing on the bulb The cricopharyngeus may retain its function in some cases or may lose some of its efficiency in others Examination during the Valsalva maneuver will often determine the efficiency of this muscle Disturbances of psychic origin are of manifold origin and are commonly found in some types of mental illness Organic disease must be excluded by careful examination before such cases are turned over to the psychiatrist

DISCUSSION

Dr. Claude C Cody noted the reference to age as a factor He believes that deficiency in vitamin B2 is frequently observed in the aged It has a bearing on the motility of the esophageal musculature through its action on the innervation This has been noted also in connection with musculature weakness in tuberculosis He inquired whether Dr Lindsay had seen any evidence of vitamin B2 deficiency

Dr. Walter B Hoover has seen cases of bilateral recurrent nerve paralysis but has failed to observe involvement of the cricopharyngeus which he believes is not innervated by the recurrent nerve, also he has observed cases of Xth nerve paralysis in which the pharynx and the vocal cord on one or both sides were paralyzed, and in which the cricopharyngeus was markedly weakened or relaxed He would like Dr Lindsay's ideas on the innervation of the cricopharyngeus from the pharyngeal plexus and whether a lesion of the upper portion of the nerve near the jugular foramen or intracranially would involve this muscle He suggests that in cases where X rays fail to demonstrate relaxation of the cricopharyngeus one might well esophagoscope the patient to rule out a possible fibrosis or web formation as the cause of the dysphagia

Dr Edwin N Broyles recalled three cases of more or less mechanical difficulties in swallowing in the region of the cricopharyngeus One case which had been diagnosed as globus hystericus was due to a web formation and the other two revealed definite fibrosis which rendered passage of the scope very difficult even under general anesthesia

Dr. S C Missal reported having seen a number of cases of poliomyelitis with marked difficulty in swallowing associated with a change in the voice yet the laryngeal function was good and the palate muscles seemed to act normally He wondered whether this alteration of the voice was not due to inadequate control of the air column by the pharyngeal sphincter

Dr Lindsay replied to Dr Cody's question by stating that the case in which X rays were shown did not have a vitamin deficiency The patient had to be tube-fed because of pain due to ulceration in the mouth and pharynx He probably had a vitamin deficiency which was rapidly overcome by the feeding, yet the difficulty persisted although to a lesser degree He emphasized the fact that his presentation was concerned mainly with the so-called functional cases rather than the organic. As for the nerve supply of the cricopharyngeus the matter is not clear Negus has admitted that he doesn't know In some cases it is difficult to determine how the cricopharyngeus is affected in cases of unilateral paralysis of the larynx and pharynx When the barium spills over into the larynx one cannot be certain whether it is due to diminished sensation or inability of the upper laryngeal mechanism to operate efficiently Usually in the bulbar polio cases the latter explanation is the more plausible

Some of the organic causes were mentioned in the paper, because they have to be ruled out before one can consider a diagnosis of functional disturbance These can usually be demonstrated in good X ray films

About the voice changes in poliomyelitis Dr Lindsay could venture no opinion however in the case of scleroderma which he cited the patient did show a weakness of the laryngeal musculature which was bilateral resulting in inability to close the glottis effectively There was a definite air loss on talking and the patient was unable to hiccough or laugh for the same reason

◆

THE GLOBUS SYNDROME AS RELATED TO DEMONSTRABLE PATHOLOGY OF THE CERVICAL SPINE.

LEWIS D MORRISON, M D

Cases of globus in the absence of demonstrable pathology in the throat should not be dismissed as purely neurogenic and turned over to the psychiatrist. The psychiatric approach is too frequently abused A careful history will often determine the mental equipment and attitude of the patient. Morrison has found that osteoarthritis is often overlooked in the X ray examination and frequently is the real cause of the disorder The X ray findings are described by the author with appropriate illustrations At times such symptoms as a grating sound in the neck on turning the head tightness of neck muscles and shooting pains may be elicited Haphazard physical therapy may do harm, but heat and light massage are always helpful. X ray therapy in small doses over a period of several weeks has proven beneficial also ACTH Cortisone gold therapy and vitamins. In some cases esophagoscopy affords relief and in a few instances surgery will have to be resorted to

DISCUSSION

DR. C. L JACKSON mentioned having recently had a patient with a condition closely resembling the last case cited by Dr Morrison. He is convinced that we need to exercise greater care in the examination of X ray films because all too frequently these alterations in the cervical spine are overlooked

DR. LOUIS H CLERF stated that all too frequently we are likely to ascribe a lump in the throat to some functional disorder which can be very unfair to the patient. On the other hand a patient may have a lot of changes in the cervical spine and not have a lump in the neck. Certainly every patient with a complaint of a lump should have the benefit of a thorough study of the cervical spine with the help of a competent roentgenologist. Dr Clerf showed a slide which indicated changes in two locations which undoubtedly were responsible for the trouble however since there was no indication for any serious intervention and since the patient was given to understand the situation, she was content to carry on inasmuch as there was no tendency for the process to become aggravated.

DR. P E. IRELAND asked the essayist about the influence of posture in this condition He was thinking of high heel shoes and open toes which orthopedic surgeons have long recognized as contributing to spinal curvature. It is also likely that a business executive sitting over a desk for hours at a time may be subject to this condition. Another possible cause is the posture when reading in bed Mention was made of a collar for support. Dr Ireland has fashioned one of a heavy felt, which the patient wears at home especially when watching television which incidentally he thinks is bad business Isn't it likely that the difficulty in swallowing may be due not only to myositis or fibrositis but also to changes in the bone?

Dr Thomas C Galloway recalled an article in the French literature several years ago in which the thesis was developed that these cases are associated with a periarthritis a process extending to the mucosa and involving the nerves in the upper portion of Auerbach's plexus He inquired what Dr Morrison thought the pathology or pathogenesis of the lipping Is the process limited to the articular end of the bone facets or a process originating in the soft tissues which may involve some of the sympathetic and vagus fibers?

Dr Arthur W Proetz requested Dr Morrison to elaborate his conclusions as to what the lump really is whether an edema a paresthesia a myositis or a muscle spasm At times the sensation of a lump is absent entirely and might be termed functional, yet it is not an imaginary thing If one could really know the essence of the disturbance in the various structures mentioned that brings about the sensation of a lump, it would be easier to direct the patient and afford him relief

Dr. Frederick T Hill ventured to add one more possible cause of this syndrome, namely, ossification of the stylohyoid membrane

Dr Morrison closed the discussion by answering the questions directed to him Posture certainly is an important factor and the collar is a useful adjunct in therapy The important thing, however, is to alert the orthopedic men and the neurosurgeon to this condition, so they may take these cases off our hands Posture such as the typist and the jeweller assume for long periods should be recognized as factors It should be noted that when fixation has lasted for a long time the pain may subside, which is why these cases grow worse as is the case with osteoarthritis As for terminology, he objects to the term "globus hystericus" and prefers telling the patients that they have a cricopharyngeus muscle syndrome complex Replying to Dr Proetz, Dr Morrison believes the symptom is due to a spasm of the cricopharyngeus muscle which does not have to be continually present Swallowing something will often relieve the condition, which is why nothing shows up in fluoroscopy Warm foods are better than cold for relaxation The article which Dr Galloway referred to is fascinating reading however he believes the author has gone off the deep end a bit in interpreting the pathology He was more impressed by an English article in which the author asked pathologists doing necropsies to investigate the tissues in this area since grossly very little evidence of the true pathology has been available The question is whether the pathology is in the bone itself the ligaments or the adjacent spaces into which calcium deposits may be laid down He has requested surgeons doing a disk operation or a fusion of the spine to obtain enough tissue for histologic study This, plus good pre- and postoperative X ray studies might go far in supplying the answers

◆

THE CLINICAL SIGNIFICANCE OF A MOTOR PATTERN IN NUCLEUS AMBIGUUS

A. C Furstenberg, M D

Experiments on monkeys by two different procedures have yielded considerable information on the distribution of the cells in the nucleus ambiguus controlling the action of the various muscles of the larynx

This knowledge may prove of great value in analyzing the complex manifestations of laryngeal dysfunction which at times has been more or less baffling. The fact that the cells of origin for the cricothyroids the abductor and adductor muscles have been identified could explain such phenomena as the loss of function of the true cords while the false cords maintain the function of closing and opening It is, therefore more than likely that isolated lesions centrally located are capable of producing bizarre combinations of laryngeal dysfunction where the activity of limited groups is affected. It may be assumed that since the pattern of localization has been demonstrated in the monkey it is logical to deduce that the motor pattern in the human being is more highly developed

DISCUSSION

Dr. Lewis F Morrison could not agree with the statement that a single muscle or portion of a muscle is incapable of being injured or affected by surgery The fact that the recurrent laryngeal nerve divides in the extralaryngeal spaces into as many as six branches makes it possible for only one branch to be damaged, thus affecting only the muscle which it supplies.

Dr. James M Robb commented on the accuracy and brevity of the presentation and suggested another field for investigation, namely the innervation of the cricopharyngeus muscle

Dr. Furstenberg agreed in reply to Dr Morrison that it is possible to affect a single muscle through one of the extralaryngeal fibers of the nerve however the complicated pattern of the nucleus ambiguus and the manifold fibers arising from its cells present a most complicated arrangement which accounts for the complex action of the various muscles which they innervate. Certainly the presentations of Drs. Lindsay and Morrison dealing with disturbed function point to the complex innervation referred to

One slide which demonstrated degeneration of cells of origin of motor fibers of the recurrent laryngeal nerve was examined by experts at Parke, Davis & Company who have been dealing with the effects of the viruses of poliomyelitis, and who confirmed without reservation the diagnosis of the type of degeneration one sees in the brain stem after section of the fibers.

The question of the nerve supply of the cricopharyngeus will sooner or later be definitely settled Another item for further investigation relates to the difficulty of obtaining regeneration of the recurrent laryngeal nerve after end-to-end anastomosis or nerve graft. It is likely that it can be ascribed to the complicated pattern of the nucleus The problem is to be able to follow the nerves in the process of regeneration all the way to their home base in the nucleus.

◆

BLASTOMYCOSIS OF THE LARYNX.

William C Thornell, M D

Dr Thornell reports an unusual case of blastomycosis of the larynx in a man of 44 a butcher The first biopsy was inconclusive tuberculosis being suspected but not proven. Streptomycin and dihydrostreptomycin failed to afford any relief The cords became progressively thickened and partially obstructing. A second biopsy preceding electrocoagulation of the cords yielded a hyperplastic mucosa containing some giant cells and spheroid bodies with refractile walls which were identified as blastomyces Some improvement followed the ingestion of iodides but when the patient failed to maintain the therapy, the obstruction became more marked Arytenoidectomy was performed on one side and then later on the other, affording considerable relief With the resumption of iodide therapy the condition was brought to a standstill Dr Thornell suggests that the aromatic diamidines be employed in these cases on the basis of some good reports following their use in blastomycosis in other areas The case which he reported emphasizes the importance of bearing in mind the possibility of blastomycosis in any case of a granuloma of the larynx once the more common lesions such as tuberculosis and carcinoma are excluded

DISCUSSION

Dr Howard W D McCart showed slides of a case which was about to have a laryngectomy on the mistaken diagnosis of carcinoma When viewed under low power 9 it did strongly suggest carcinoma, however, the high power was able to show the marked hyperplasia The condition cleared up entirely within a few weeks under stilbamidine 150 mg

Dr James M Robb, commenting on the difficulty in diagnosing lesions of this sort recalled the case of a woman of 40, who presented a small lump on the side of the neck which became red and tender It was opened and drained and the material sent to the laboratory Tuberculosis, histoplasmosis and blastomycosis were ruled out. The pathologist suggested cat scratch fever, and comparison with a report on this entity in the New England Medical Journal proved it It is called nonspecific regional lymph adenitis, and in this case was cured by potassium iodide

Dr Lewis F Morrison inquired whether the organism shown in the cells in the slide presented were still present at the time of the arytenoidectomy

Dr Thornell replied that the organisms were found in the tissue at the time of the arytenoidectomy, even though the patient had had several courses of iodide therapy It was difficult to keep the patient on the medication, but after complications developed he became more tractable and is reporting back frequently for observation

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LARYNGEAL PAPILLOMATA SURGICAL TECHNIQUE FOR REMOVAL OF RECURRING AND OBSTRUCTIVE GROWTHS

DeGraaf Woodman, M D

Dr Woodman described a case of recurring laryngeal papillomata in an adult which was cured by a thyrotomy and resection of the tumor bearing mucosa of the larynx which involved both cords and ventricular area An acrylic mold was placed in the larynx attached to the tracheotomy tube and left *in situ* for eight weeks When it was removed the operated area was seen to be completely healed and covered with normal appearing mucous membrane One cord was immobile, and the other had some adductor function The voice was a hard whisper adequate for the telephone airway was sufficient, and function of the upper part of the glottis was active.

Since the operation two growths have been removed from the trachea but the larynx has remained free

The patient seemed to have a diathesis for mucosal pathology She had undergone treatment for intramucosal carcinoma of the cervix and also was found to have papillomata in the bladder

DISCUSSION

Dr. Edwin N Broyles stated that generally speaking thyrotomy is not indicated in these cases in children because of recurrences despite the surgery however if one is dealing with the adeno type of papilloma, one may be successful because this type shows less tendency to recur In Dr Woodman's case where the growths were present in the trachea, it seems doubtful whether the results would be final He certainly hoped Dr Woodman would get away with it It is true that through the laryngoscope one is unable to do a submucous resection of the growths which is the secret of complete removal therefore the operation described by Dr Woodman may have much more to offer

Dr. Lewis F Morrison asked whether terramycin or aeromycin had been used pre- or postoperatively They have in certain instances proved effective

Dr. Murdock S Equen mentioned the case of a cheer leader who had been operated on a number of times in various clinics and finally developed a malignancy which necessitated a laryngectomy It proves that these cases should not be taken lightly

Dr. Fred Z. Havens would not advise this procedure in children, but did think that in adults where the condition is more amenable they might benefit by it. Reference has been made to possible malignant changes A patient on whom he had operated at the age of 12 or 13 had growths in the trachea which were pronounced malignant, yet the clinical course did not substantiate the diagnosis since the patient kept having recurrences up to the age of 22 or 23 when last seen A review of the earlier slides still classified them as malignancy however the patient is practically cured except for an occasional limited growth The numerous operations led to a stenosis which Dr Havens plans to correct with a skin graft. In this case a thyrotomy proved the inadequacy of removal under endoscopy because of the inaccessibility of nodules deeply situated in the ventricles.

Dr. Woodman concluded by stating that he had been hesitant about the procedure after hearing of failures elsewhere however the experience of many with *implantation* at the site of the surgical trauma impelled him to seek the more radical procedure in this case Thus far the result has been good it being already 14 months since the operation. She did have antibiotics at various times without result.

Dr Woodman recalled a discussion in which it was stated that removal of the growths followed by the application of podophyllin had been successful in preventing recurrence.

DALLAS ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

PROGRAM 1955 - 1956

Tuesday, December 6, 1955

3 00 P M —Program
Streak Retinoscopy
Mr Jack C Copeland, Chicago, Illinois
Parkland Hospital—Doctor's Lounge

6 30 P M —Dinner, Parkland Hospital Dining Room

7 30 P M —Diagnosis in Rhinoplasty
Dr Ralph H Riggs, Shreveport, Louisiana

8 00 P M —Streak Retinoscopy Continued

STANFORD UNIVERSITY SCHOOL OF MEDICINE POSTGRADUATE COURSE

A Postgraduate Conference in Otorhinolaryngology will be presented by the Division of Otorhinolaryngology, Stanford University School of Medicine, March 26-30, 1956 This Conference will offer a comprehensive survey of the current field of Ear, Nose and Throat Presentations will be didactic, by individuals and panel-groups Some of the subjects will be basic science reviews, such as anatomy (using three-dimensional projection) and pathology, audiology including psychogalvanic skin response, ear surgery, including stapes mobilization, nose and sinus problems, including rhinoplasty, pituitary surgery, allergy and steroid therapy, throat diseases including suspension laryngoscopy, laryngoplasty (*e g* use of tantalum plate), and laryngectomy with neck dissection, speech problems, bronchoscopy and esophagoscopy, etc.

Registration is limited to 30 Doctors of Medicine in E N T or E E N T, and the fee is $100 00 Application may be made to Office of the Dean, Stanford School of Medicine, 2398 Sacramento Street, San Francisco 15, California

NATIONAL SOCIETY MEETINGS

Schedule of Meetings for 1956

American Laryngological, Rhinological, and Otological Society Inc.

Eastern Section, to be held at the Statler Hotel, Boston, Mass , January 13

Middle Section, to be held at the Netherlands Plaza, Cincinnati, Ohio, January 16

Western Section, to be held at the County Medical Society Bldg San Francisco, Calif , January 21

Southern Section to be held at the Shamrock, Houston, Texas, January 27-28

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American Board of Otolaryngology, to be held at the Sheraton Mt. Royal, Montreal, Canada, May 6-11

American Otological Society, Inc , to be held at the Seigniory Club Montreal Canada, May 11-12

American Laryngological Association to be held at the Seigniory Club, Montreal, Canada May 13-14

American Broncho-Esophagological Association, to be held at the Sheraton Mt Royal Montreal, Canada, May 15 16, (afternoons)

The American Laryngological, Rhinological and Otological Society, Inc., will hold its Annual Meeting at the Sheraton Mt. Royal, Montreal Canada, May 15 16-17 (mornings only)

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Under the joint sponsorship of the Departments of Oto-Laryngology of the L S U School of Medicine and Tulane School of Medicine a course in Reconstructive Surgery of the Nasal Septum and External Pyramid will be presented in New Orleans March 10-17 (inclusive), 1956

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Basic Sciences in Otolaryngology
September through June

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*Our subscribers are asked to send us information on other institutions giving such courses

THE
LARYNGOSCOPE.

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NUTRITION AND RELATED PROBLEMS

ISAAC H JONES, M D ,
Los Angeles, Calif ,

HAROLD S MUCKLESTON, M.D ,
Pomona Calif

and

JEROME A HILGER, M D
St Paul Minn

The physical ills that afflict mankind, it has seemed to us fall into two groups Of course both of these are concerned with Nutrition—as is every phase of life, in sickness and in health

Group I the main subject of this editorial, includes the five subjects Endocrine, Autonomic, Stress, Allergy—and Nutrition as it affects them or is affected by them. This group naturally concerns the physician, whether a specialist or a general practitioner, but lies particularly close to the daily practice of the otolaryngologist.

Group II consists of Infection, Neoplasm, Trauma, Heredity (including Congenital Abnormality)—and Nutrition as it concerns them

'The writer must so write that his readers not only may but must, understand " These were the words of Quintilian[1] nineteen hundred years ago Let no reader suspect us of trying to prove anything, that is farthest from our thought or interest We are simply recording our own impressions from the study and care of the sick

We were led to this concept of two groups by the following facts and experiences To some, nutrition means simply food, if, however, it is defined as the sum of all processes whereby the body is nourished, Nutrition involves these other related subjects In clinical practice, at any rate, Nutrition, Endocrine, Autonomic Influence, Stress, and Allergy are all closely interwoven Nobody can study an article on any one of these five problems without being struck by its close relation to one or more of the others The understanding of one is certainly not clear without an understanding of them all Each of these five subjects is elaborately presented in the literature, *separately*, but it has seemed to us that they might be considered together, as the thumb and fingers of a hand

Of all the problems in medicine, is there no other that belongs with these "five fingers"? The answer seems to be "No," for we feel that the others, of Group II, not intimately related to one another, may be considered as "on the other hand" To be sure, there are sometimes interrelations between the two groups, for example, trauma is definitely productive of stress Consequently, the right hand and the left occasionally join in a hand-shake

The approach to *treatment* of infection, neoplasm or trauma is on the average not difficult to determine, but we clinicians, absorbed in providing help for the patient, approach the five other problems with less assurance

Now, to discuss this Group I Of course, Stress, like Nutrition, is all-embracing—including the human soul! It is an active factor in the life of every man, no matter what disease he happens to have Often, however, we think we are bearing a cross, when we are merely putting up with ourselves Even Shakespeare challenges the physician "Canst thou not minister to a mind diseas'd, pluck from the memory a rooted sorrow?"* Milton goes further in saying "The mind is its own place, and in itself can make a heaven of hell, a hell of heaven"† Obviously, it is idle to limit Stress to a single group, yet it exerts its good influence (stimulus to achieve), or its dire influence (*distress*), each through the autonomic system, and so may conveniently be placed in Group I.

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* Macbeth act V sc 3

† *Paradise Lost* bk 1 lines 254-5

The *eosinophil* belongs to Group I, not to Group II

It has been in our minds for a long time that, if only we could come to understand the *eosinophil*, we would have a better grasp not only of nutrition but of the related subjects "Comment is free but a fact is sacred ' At the moment we cannot know the facts about the eosinophil, and so various comments are in order

The eosinophil and also, for that matter, allergy itself are attributed to the action of enzymes by Godlowski[2] in his book reporting his original work. It has been estimated that the protein of all the cells of the body is replaced every ninety days[18] When the protein reaches the cell, if it has already been split into its terminal amino acids, all is well and it can be appropriated by the cell If, however, it has not been sufficiently split into the innocuous amino acids, it changes the physico-chemistry within the cell As he sees it the tissue cell and also the leucocyte or histocyte can thereby be sensitized For a substance to enter a cell, a particle of appropriate size must be adjacent to an open "cortical fenestra" and also a force must be available to drive it through the cortex into the interior of the cell This is true of the original sensitizing invasion, and also of the shock dose which may come later

This second assault can cause the liberation of toxins, with resultant edema and eosinophilia To the rescue comes the adrenal that ' Watch-dog of the Treasury " In other words, toxic metabolites are released which evoke the pituitary-adrenal response This reduces the exudate and cuts down the number of eosinophils The factors in everyday living that produce stress can have the same effect. In passing it is of interest that this process can result in harm as well as good if it permits the spreading of a quiescent infection A focus of infection, like tuberculosis, may be cut off from the rest of the body by a wall of tissue hence corticosteroids can destroy the barriers surrounding the focus To Godlowski it appears that the eosinophil can be formed wherever the white cell or local histocyte can be insulted Such a cell then bears the features of an insufficiency, it is no longer adequate for the performance of its normal function In brief, he considers that this change into an eosinophil deprives the cell of its original morphology and primary function

It would seem that some good thing might be said about eosinophils In small numbers they are present in everyone, even those in apparent perfection of health, however, when the otolaryngologist finds them in the nasal smears and blood count of an allergy patient, he is inclined to liken the eosinophil to the title of a book well known to our parents and regard them as stained by the stigma of "The Scarlet Letter "* This, however, is by no means the orthodox view The prevailing opinion is that we do not know where or how the eosinophil is born or what becomes of it when the adrenal cortex causes it to fade from the picture

There appears to be a recognized sequence in Allergy, including all five of Group I An irritant food or other offender sensitizes the cell, and by a later assault causes it to produce toxins with the allergic result—edema and eosinophils, the stress, through the autonomic system, causes the adrenal cortex to come to the rescue with its steroids poured into the blood stream

Thus the eosinophil is an intimate factor in the interrelation of the five members of Group I—nutrition, endocrine, autonomic, stress and allergy So once again these five seem like strands of different nature that are woven together into one single cloth

In all other afflictions, like those from infection, trauma or neoplasm, the eosinophil is seldom in evidence In prodigious numbers infection brings forth the life-saving leucocyte but not the eosinophil Eosinophils are found in patients who have certain intestinal worms, but this is an infestation not merely an infection In the acute stage of trichinosis there are fever, high leucocyte and eosinophil counts and a strongly positive diazo reaction in the urine Buylla, Llavona and Villaroya[3] encountered an outbreak and battled in with ACTH, giving the victims an average daily dose of 60 mg, for periods varying from 8 to 18 days They saw quick relief from fever, dyspnea, muscular stiffness and nervous symptoms There were relapses in some patients and a second course of ACTH was necessary Only one patient was refractory to this therapy It seems that the allergic inflammatory reaction of the tissues was modified or controlled by corticotropin The use of the drug is stopped when the diazo reaction in the urine becomes negative

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* Nathaniel Hawthorne 1804-64 The Scarlet Letter published 1850

As Macfarlane[4] expresses it When a subject becomes sensitized to some allergen and is subsequently exposed to it, as in sufferers from asthma, hay fever urticaria, or certain skin diseases or in parasitic infestation with absorption of foreign protein there is usually an eosinophilia, reaching in extreme cases as in trichinosis as high as 30,000 Dent and Carrero[5] report similar counts in infestation by toxocara canis

From breast feeding to old age the food problems of the allergic individual are presented and simplified by Bucher,[6] who feels that what seem to be insignificant changes in the diet will frequently bring about a desired result. Enzymes are complex compounds capable of speeding up chemical reactions, while the enzyme itself remains unchanged in the process. In brief the enzyme is a catalyst. When faced with these problems of biochemistry most of us are only too pleased to have the facts simplified as far as possible The pancreas with the aid of other active glands and cells normally secretes a sufficient concentration of enzymes to combine with all foods ingested plus an excess which passes into the blood stream Every normal cell in the body is thus protected against foods in the original state A large number of active enzymes distributed to all tissues and cells is required for the processes of normal metabolism The first group of enzymes digests the foods into their ultimate product—carbohydrates into sugar fats into fatty acids and glycerin, and proteins into amino acids, however, these end-products of protein digestion must be further acted upon before they become a part of living cells A second group of enzymes reconstitutes the amino acids to proteins, comprising the protoplasm of living cells Each enzyme exerts its action only upon substances whose molecules have a certain definite structural arrangement The enzymes that act upon simple sugars are not capable of affecting complex sugars There is no evidence that any single enzyme can produce more than one kind of ferment action During the process of "hydrolysis," proteins are converted into proteose, peptones, polypeptides and finally amino acids Hydrolysis is a process whereby a compound takes up oxygen and hydrogen in the proportion forming water, and is thereby resolved into another compound. The result is called splitting—protein splitting, fat splitting, starch splitting On the market are several commercially prepared hydrolyzed proteins, these are less allergenic than the original product They are less expensive than pure amino acids They are obtainable with or without the addition of fats, carbohydrates or vitamins Gelatin is the only protein that never produces an allergic reaction When ingested, it very quickly breaks down to amino acids, so that the body is not dealing with the gelatin molecule but rather with the broken down products of gelatin which are not allergenic Also when a protein is rendered less resistant to digestion, as by cooking, it becomes less allergenic.

Years ago, the pioneer, Rowe, stated that infection led the parade of all the ills, but that allergy was second

All fields of clinical medicine are replete with disturbances of physiology that go on to conditions of pathology—sometimes irreversible These step-by-step processes go through successive phases of cell-exhaustion or cell-starvation Often the exhaustion is but a stage of starvation in that the period of replenishment never occurs, or is never allowed to occur

Even though our knowledge is so limited, we know already that the complex human organism contains checks and balances in the form of enzymes and hormones to help restore the cell Irregularities in autonomic innervation, in the orderly immunologic process and in smooth endocrine interaction, can impede the restoration of these microscopic building blocks, the cells, just the same as the lack of nutrient substances

Confucius would have cheerfully endorsed the later Chinese proverb, 'Order is Heaven's first law'" In the composite whole those functions that *preserve order*—nutrient, endocrine, autonomic environmental and immunologic—constitute the keystone of the *normal physiologic process* The basis of their interaction at the cellular level is as yet poorly understood, but the importance of each is clinical fact. These functions within Group I are all *normal*, only when they fail in their normal duty is the patient sick. What a contrast to Group II! There is nothing normal in infection neoplasm trauma or hereditary taint It is obvious that there is this pronounced difference between the two groups, one is a normal mechanism out of order, the other a direct affliction—a disease

Thus it appears that Group I—malnutrition, endocrine imbalance, autonomic dysfunction, stress and allergy — are precursors of disease processes, so interwoven and similar as sometimes to defy separation It is probable that their malfunction sums up as cell starvation, irreversible change and established pathology

As with most surgical specialties otolaryngology grew up on the surgical removal of diseased tissue As our specialty comes of age and justifies its existence, its prime focus has happily shifted to the recognition of disturbed function and the prevention of disease

As a source, the otolaryngologic literature is poor in the fundamentals. Most of the basic work is done in other medical fields Hence the aim and, perhaps the justification for an annual report on Nutrition — this the fourteenth — is the presentation of our concept of the Two Groups in Medicine, and of the changes and additions recently wrought in it. At last Nutrition begins to interest all physicians It is our hope that, to the already accumulated wealth of gold, we may be contributing a bright penny

In presenting the following, we recall the words of Montaigne[8] "I have gathered a posy of other men's flowers, and have brought nothing of my own but the thread that ties them together "

NUTRITION

Escorting us back to the remotest ages of the past, before the appearance of the first cell, Szent Gyorgi[9] says, paradoxically, that the longest period of life was the pre-cellular era when there was no life From the first cell Nature built higher and more complex organisms, not making the cell more complex but multiplying it and allowing the new cells to differentiate Every cell is the center of its own Universe which is divisible into two parts—the inside and the outside, with a plane separating them, called the "membrane" Being permeable, this membrane permits the passing of ions to and fro, and its permeability, influenced by certain steroids, regulates the intracellular atmosphere which controls the cell's internal machinery The passage of ions, in and out through the membrane, is a vital process The potassium ions are dominant To the question, "Is the potassium ion free or not free?" Szent Gyorgi replies, "Free? Yes," and "Not free? Yes" He compares it to a married man, "allowed to do anything his wife wants him to do" So many potassium ions passing in, so many passing out, there is no static equilibrium, but the situation constantly changes, bringing to mind Karr's century-old epigram, "Plus ça change, plus c'est la même chose"* There is ample evidence that, if a heart dies, poisoned by the products of infection, the only thing that has gone wrong is the membrane of its cells which has become too permeable to potassium

One of our closest friends was Manager of the Research Study Club since its beginning in 1922 In him we have a picture of disturbances of all five members of Group I, Nutrition, Endocrine, Autonomic, Stress and Allergy (though little of the last) He was well known to a large number of the readers of this magazine Those who have attended the

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* 'The more it changes the more it remains the same' Alphonse Karr, 1808 1890

Midwinter *Convention* will not forget this genial man with the monstrous abdomen Each one wondered what had caused his trouble Through the years the only explanation we have found is "war stress" In 1917, when he enlisted in the service at age twenty three, he was well built, an expert swimmer and a speedy trackman He spent eighteen and one-half months overseas with the Rainbow Division, much of the time under fire, enduring much mental and physical strain His was a very sensitive soul For a year or more after the war it was extremely difficult for him to meet people—he was intensely nervous, cried frequently and suffered violent headaches, some so severe that "he was out of his head" "Shell shock" was the term then in use At this time he began to gain weight, pound after pound, until he weighed 360, his obesity being chiefly in the abdomen It was not from overeating, in fact he tried dieting exercise—everything—without success All his physicians said "the trouble is glandular" but no treatment was of avail except insulin for the diabetes which had developed At age fifty-eight he suffered an acute myocardial infarction and died nine days later The autopsy disclosed severe generalized arteriosclerosis, coronary thrombosis with massive myocardial infarction, fibrosis of the *islands of* Langerhans and obesity, unfortunately, it did not include an examination of the brain, therefore there was no study of the hypothalamus

Obesity as a problem, should interest all physicians It even concerns some of them personally If the average weight at ages 25 to 30 years continues to be maintained, it confers a maximal life expectancy For his height and build, no one throughout life should weigh more than the average person weighs at age 30 Frequently the physician fails to emphasize the seriousness of obesity, so in presenting this state of affairs Rynearson and Gastineau[10] urge us to develop a missionary spirit and zeal in its correction The facts are clear In war time countries short of food have noted a decrease in degenerative diseases, in this sense they are blessed in being without their usual food supply These authors contend that as fat comes only from food, obesity results simply from eating more than is required Too much food creates a stress with which the body has only limited ability to cope, so when the body is carrying a load greater than it was designed for, it is like a passenger car motor being used to propel a truck Damage to the hypothalamus also has a striking effect in producing obesity, this suggests that an important center for appetite regulation resides there The effect of odor and sight of food in arousing appetite, and even of mere memories of good meals, is familiar to everyone After damage to the hypothalamus, obesity results from the voracious, ravenous appetite which begins abruptly after the injury Such injury has been shown to interfere also with other important self-regulating functions—temperature control, water balance, gastro-intestinal function and even sleep Since some lesions of the hypothalamus will produce obesity and others will cause genital hypoplasia, it appears probable that the responsible centers are separated anatomically During periods of stress some people smoke, some drink, while others eat and become fat Supplemental thyroid has been used in obesity since 1891 It gained early favor, until time proved that hypothyroidism was only occasionally associated with obesity As to exercise, one may lose one pound by walking thirty-six miles, however, exercise tends to increase the appetite In excess of basal requirements, hard physical labor may cause additional consumption of as much as 2,000 calories a day

In contrast to the above, there are many who consider that this frustrating problem has too often been dismissed as a simple habit of overeating, presumably to be cured by discipline It is believed by Van Itallie, Mayer and Stare[11] that obesity can best be placed in proper perspective when viewed as an end-product for which many different factors can be responsible To be sure, obesity can develop only if there is a prolonged imbalance between energy intake and output To understand the cause of such an imbalance, the normal mechanism of food intake must be understood, and our present knowledge concerning this important mechanism is sketchy

In Britain obesity is unquestionably the commonest nutritional disorder, and Meiklejohn[12] considers it responsible for more ill-health than all the vitamin deficiencies put together

The American male, if twenty-five pounds overweight at age 45, has his life expectancy reduced by 25 per cent It would seem that for those who "laugh and grow fat," the laughter is frequently hollow Endocrinology has given the physician a useful escape from the distasteful task of telling his patients they are greedy it can all be "blamed on the glands" The lack of any positive evidence has led to a return to the earlier belief that the vast majority simply eat too much, either because of sheer gluttony or because of a disorder of the hypothalamus, yet some who eat surprisingly little still become fat There is undoubtedly an endogenous or metabolic cause of obesity, as well as the exogenous one of simple overeating The only possible origin of the fat is food it does not come out of the air The unknown factor is the metabolic process in storing it Perhaps normal people have some means, as yet undefined of disposing of surplus calories This may be impaired in the obese Certainly many normal people regularly take more calories than their bodies need, yet without becoming obese. In brief what the normal body would eliminate as heat, the obese body stores as fat The hypothalamus is undoubtedly concerned with the regulation of appetite, damage to it can directly produce an excessive appetite Finally, it also seems that overeating can be due to stimuli from the cerebral cortex, directed to the hypothalamus which in turn, controls the numerous neural and endocrine mechanisms affecting appetite and the utilization of food The complicated relationships between the mind, the hypothalamus, the anterior pituitary, the pancreas and no doubt other regulatory mechanisms are imperfectly understood, but we already have sufficient insight to regard many cases of obesity as suffering from a true psychosomatic disease

In their study of older people Shea, Jones and Stare[13] find that women are able to maintain their weight on a daily caloric intake of 1500 calories or even less For men it is nearer 2000 Further they suggest that the caloric intake be reduced 5 to 7 per cent for each decade beyond age 25 Thus a moderately active man who was maintaining his weight at age 25 with a daily consumption of 3000 calories should limit himself to 2400 at age 65 and to 2800 at age 75

If he is no longer active, as in most instances, the caloric allowance should be decreased even further Protein is in a constant state of flux in the aged individual just as it is in the young It has been calculated that there is a complete turnover of body proteins every ninety days as the body tissues are broken down and repaired Since excess protein is *not stored* in the body, regular daily consumption is necessary With age, the proportion of total calories derived from fat should be decreased Fat is more slowly digested than carbohydrates and proteins, but there should be a sufficient amount of the essential fatty acids as these may play a role in maintaining healthy skin Constipation is no more common in the aged than in the young Old people just talk about it more

Under the broad heading, "Nutrition and Disease," Spies[14] has assembled reports of some ninety cases One of these illustrates the wisdom of treating the patient for general welfare, and not concentrating on just one aspect The patient suffered from combined hypertension and obesity Her weight was 215 pounds and her blood pressure 178/110 On a reduction diet, in five months she lost 21 pounds and in the next three months another 15 pounds, concurrently there was a steady drop in blood pressure, to 108/72 Her basic trouble was clearly obesity It is said that 20 per cent of our population are obese

The separation of the process of senescence, *per se*, from the chronic diseases seems to Davidson[15] to be difficult, but he regards it as common knowledge that many of these degenerative diseases are nutritional and can be so treated As one would expect, there is an increase in fat content of the body with aging, particularly in women, this is associated with a decline in muscle mass With increasing obesity there is a marked increase in mortality, due largely to cardiovascular and renal disease and to diabetes There is also some evidence that weight reduction is accompanied by a reduction in mortality It is recognized that psychic stress may lead to overweight, by operating through the hypothalamus, just as injury to certain areas of the hypothalamus in animals will cause an increase of appetite and weight

It now seems that intestinal bacteria definitely contribute to the wellbeing of the host by synthesis of water soluble vitamins This has been well established in ruminants and Stokstad[16] shows abundant data suggesting a similar synthesis of vitamins in the intestinal tract of single-stomached animals The recognition that antibiotics can increase the growth rate of animals has given a new insight into the function of intestinal flora and has naturally given rise to much speculation Certain antibiotics produce a decrease in some bacteria and an increase in others The marked effect of antibiotics on slow-growing pigs naturally suggested a similar experiment for slow growing children, of course with careful controls Antibiotics were given to premature infants, and also to poorly developed and undernourished children With twins and triplets the antibiotic was given to the weaker or weakest one. The results on animals and children alike have been sufficiently good to warrant further tests

It is logical to expect that the rate of growth of an animal will be increased when infection is eliminated This in a nutshell, is the reason given by Jukes and Williams[17] for feeding antibiotics They found that adding small quantities of antibiotics to the diets of young animals not only served to control certain obvious infections but also produced unexpected increases in the growth rate even when the animals showed no evidence of infection It is suggested that microorganisms which slow down the rate of growth must occur commonly in the digestive tracts of animals Just a trace of antibiotics has created a near-revolution in poultry and live stock raising The animals require less food and yet show an increase in size and weight. It seemed from the first that the effect of the antibiotics on growth was due to their attack on the intestinal flora. This growth effect is produced by several substances but the only known property which they have in common is their antibacterial potency The growth of human beings takes place so much more slowly that such growth responses to antibiotics are not to be anticipated in infants A pig grows to a weight of 50 kg in about one-fiftieth of the time taken by human beings to attain this weight. The effect of antibiotics is not obtained in environ ments in which bacteria are absent, such as in the chick embryo or in "germ-free" chicks, and the growth effect may be reduced when the animals are kept under highly sanitary conditions It seems evident, therefore, that certain antibiotic-sensitive intestinal microorganisms interfere with the utilization of food The tissues of antibiotic-fed animals are of normal composition The practice of feeding antibiotics to farm animals is now widespread No untoward effects on public health have resulted Detectable amounts of antibiotics are not found in meat even when the animals are fed antibiotics at levels far higher than usual, furthermore, many antibiotics are destroyed by cooking The daily administration to children of small amounts of aureomycin for prolonged periods was found to have no unfavorable effect

To honor Albert Szent-Gyorgi, Nobel Prize winner, the New York Academy of Sciences conducted a conference on "Bioflavonoids and the Capillary" His investigations of the properties of extracts of citrus fruits, especially the pulp and peel of the lemon, began some twenty years ago, he determined the presence of a substance which so acts upon the capillary wall as to lessen its permeability, and believed it to be a single entity which he named "Vitamin P" (for permeability) Later work dispelled the concept of a true vitamin and revealed the existence of substances characterized by a yellow pigment and called flavonoids (Latin *flavus*-yellow) or bioflavonoids, in them lies the power to reduce the permeability of capillary walls and thus to control or lessen capillary bleeding The conference brought together workers in the citrus and pharmaceutical industries, agricultural and university laboratories, and clinics Zweifach[13] enumerates the five parts of the capillary wall, the one through which pass large molecular aggregates and formed elements is the intercellular cement In patients under coumarin anticoagulant therapy, Brambel[14] found evidence of capillary fragility, such as ecchymotic areas, in five percent, by the use of hesperidin and "C" in combination (the now generally accepted practice) bleeding was arrested and there was rapid clearing of the ecchymoses The ravages of rheumatic fever were depicted by Rinehart[15], the initial reaction to the "rheumatic injury" involves a swelling of the connective tissue ground substance, to whose economy "C" and the bioflavonoids are important, epistaxis, a commonly encountered complication, is reported to be reduced in its incidence and severity by these agents, the records of the Royal Navy support the belief that a deficiency of "C", in the presence of hemolytic streptococcal infection, disposes to the development of rheumatic fever, admitting that direct evidence is limited, Rinehart finds much to support the view that the use of "C' and bioflavonoids, in prophylaxis and treatment of rheumatic fever, is basically sound Likewise Javert[17] has found, in cases of repeated abortion, that the lack of "C" and hesperidin is often a determining factor and that it can be overcome by their use Poliomyelitis, in turn, offers occasion for the same mode of treatment, Boines[18] adopts the dictum "an intact capillary system means a solvent body," and reports that in all his cases of severe acute infection there was capillary fragility and that "C" with hesperidin effected improvement in 80 percent, in an average period of five weeks

It remained for Youmans[18] to summarize the clinical aspects of bioflavonoids and ascorbic acid, a deficiency of "C can be blamed for bleeding from the capillaries its presence is necessary for the integrity of their walls the role of the bioflavonoids is inferred from indirect evidence only we need additional indices, additional measures of determination, in order to arrive at a more clear-cut understanding of their action and mechanism However, he concludes, when one is dealing with human subjects and human illness, one is forced into empiricism more than to one's liking and must depend primarily on the therapeutic result Fittingly Szent-Györgi[19] was the last speaker he deprecated the hard and fast division of the substances under discussion into 'vitamins" and 'drugs", for perhaps there is something between Are the yellow pigment bodies normal constituents of the cell? He knows of no proof, and calls for an attitude of caution He has extracted from the thymus a strongly yellow substance giving most reactions typical of flavonoids, further search may lead to a better grasp of the thymus' function "Flavonoids represent one of the most exciting, broad and hopeful fields of biological inquiry, and I am glad to close on such an optimistic note"

ENDOCRINE

At the turn of the century a student was asked if he knew the cause of diabetes "I did know once, sir, but I have forgotten" The Professor said "What a pity — now no one knows" To this day no one knows completely, but Bishop[19] says that through endocrine studies the secrets of diabetes are gradually being revealed Blood glucose remains remarkably constant, it is disposed of by being converted into fat and muscle glycogen This is facilitated by insulin—indeed this is probably the principal function of insulin Sugar is stored in the liver as glycogen The conversion of liver glycogen to sugar in the circulation is largely adjusted by the blood glucose level When it tends to fall more glycogen is released, if it tends to rise more glycogen is stored When the blood glucose is converted into tissue glycogen, the glucose combines with phosphoric acid The most important role is played by the enzyme, hexokinase, and its action is helped by insulin In normal circumstances muscle glycogen is the main source of body energy, the glycogen is oxidized, yielding carbon dioxide and water Should there be limited glycogen stores, fat is mobilized and acts as the main source of energy Probably the most important effect of insulin concerns the utilization of blood sugar by the tissues The formation of liver glycogen is greater than that of tissue glycogen

So we do not know how insulin works In fact, to those who have a small acquaintance with the vast subject of diabetes it is almost a shock to have Stadie[20] state that in the light of the evidence presented it is impossible at present to espouse one theory of insulin action to the complete exclusion of any other, yet it is with reluctance that one would abandon the hope that the interactions of insulin will become explained upon the basis of one single mechanism

An adenoidectomy—will the child bleed profusely in the hours following? An epistaxis—what will happen after the packing has been removed? Menger[21] has used conjugated estrogen substances in such crises when routine procedures had failed to arrest bleeding He reports six cases of epistaxis In one, the bleeding had persisted for three days and trans fusion, 'K" and other agents did not stop it but 20 mg of conjugated equine estrogens given in the vein succeeded in doing so in one hour, a minor bleeding three days later yielded to the same treatment in 30 minutes He reports also ten cases of bleeding in young children, following the removal of an adenoid, the estrogen was given in the gluteal muscles, in amounts of 5 or 10 mg according to the weight of the child, no bleeding after a period of from one-half to two hours It may be that the female hormone restores the integrity of the blood vessels, it may speed up the clotting time or provide some missing factor, it may stimulate the release of thrombocytes into the circulation Menger admits the empiricism of the therapy, but bases his estimate of its value on his own experiences

In meningococcic infections two factors dominate the course, the infection itself and the action of the adrenal cortex Bartolozzi and Borgheresi[22] find that in the fulminant cases the protection afforded by corticotropin is seriously impaired and there is a correspondingly high eosinophil count, by the use of cortisone the patient is enabled to derive benefit from antibiotic therapy The effect of the cortisone is reflected in a falling of the eosinophil count, and a regression of the state of collapse in this period the victim is actually kept alive until the antibiotic can control the infection In more moderate infections the eosinophil count is low, indicating good adrenal function, cortisone speeds the recovery in some cases not in all Accordingly the authors ascribe high value to the use of cortisone in severe fulminant infections, less value when the stress of the disease is mild The eosinophil count reflects the activity or non activity of the adrenal cortex and is a positive indication for the use of the hormone when its non function threatens failure to meet the demands of the infection

AUTONOMIC

In the light of recent knowledge it now seems natural to think of the hypothalamus and the pituitary as almost inseparable parts of a functional unit The main structural features of the pituitary are obvious even to the naked eye, but Kennedy[23] notes that the structure of the hypothalamus remains something of a mystery Early experiments, of which there were many, were inconclusive because the hypothalamus was always approached from below, so that the pituitary also was inevitably damaged The crucial experiments demonstrating that the hypothalamus could be damaged so as to cause obesity, introduced an electrode from above, without any harm to the pituitary, so now there is no reasonable doubt that the cause of the obesity often associated with damage to structures in the pituitary region lies in the hypothalamus and not in the gland itself The most important factor is an increase in food intake, and bilateral lesions of the ventromedial nuclei of the hypothalamus were necessary to produce this result The original work was done on the rat and confirmatory studies have been done on the cat, the dog and the monkey and it is a reasonable assumption from clinical evidence that a similar mechanism operates in man At any stage after the development of the obesity, the rat can be reduced to the same weight as its control by starvation, if it then receives excess food again, the whole picture is reproduced and the animal again reaches about the same degree of obesity Determination of the fat content of the most obese rats shows that the fraction of their body formed by fat is almost identical with that in very fat women as well as in fat pigs Initially the feeding is voracious, but the animal's behavior becomes more normal as it becomes fatter

In higher animals the sensitive mechanism controlling food intake is thought to be located in the brain, since all of the reactions for finding and eating food are directed by the central nervous system If there is only one sensitive region having this function, Brobeck[24] considers that it is probably located in the hypothalamus Within this remarkable hypothalamus, two mechanisms appear to be separable, one, in the lateral regions, is required for eating and has been called a feeding center, the other, in the medial hypothalamus, evidently acts to inhibit either these lateral mechanisms, or the lower mechanisms which take part in feeding The lateral mechanism may be responsible for appetite and the medial mechanism for satiety

STRESS

'Galen's art heals only the body,
But Maimuni's skill heals both the body and the soul.

For evil and ignorance flee from his presence,
When Maimuni arrives, all suffering departs"*

Compressed into five pages of a popular magazine, Ratcliff's[33] story of Hans Selye recounts his development of the concept of Stress as a prime cause of disease. Even in his student days at the German University of Prague, Selye rejected the teaching that most disease is caused by bacteria and nothing else counted very much Hormones and stress opened unknown territory He came to this country and for a time studied at Baltimore Later, he moved to Montreal where he engaged in research for ten years at McGill University, in 1945 he became head of the Institute of Experimental Medicine at the University of Montreal Selye exposed animals to stress in one form or another and saw them sicken and die, he traced the effects of the stress through pituitary and adrenal glands to arterial and renal disease, to arthritis and to damaged lymphatic systems The secret lay in endocrine imbalance, a story now familiar to every medical reader but ever new in its significance.

In his book on Stress Wolff[34] views the many problems involved as they affect individuals and peoples Wartime conditions in Norway in the late war resulted in a striking rise in the incidence of hyperthyroidism, especially in the female part of the population In Central India society is undergoing a rapid cultural change among the more opulent citizenry, whereas the villagers continue to follow the standards of their forebears, the "Westernized" Indians of the cities are more subject to intestinal disorders, to neurocirculatory asthenia

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[*] From a tribute to Maimonides, written by Alsaid Ibn Sina Almulk when he learned of Maimonides death in 1204

and to asthma than their ignorant and underfed fellow-countrymen of the small communities and farms

The note of group psychology is also sounded by Wolff in a "Lecture to the Laity" Man is a tribal or group creature, with a long period of dependence and development He is dependent for his very existence upon the aid, support and encouragement of other men He lives his life so much in contact with men and in such concern about their expectations of him that he is jeopardized as well as supported by his fellows, indeed, he may feel more threatened by cultural and individual pressures than by other environmental forces He must be part of the tribe, and yet he is driven to fulfill his own proclivities These pressures and the conflicts they engender are ubiquitous and create a large portion of man's stress

Stress from terror reaches the ultimate in its effect on the ignorant and superstitious Hume[78] tells of a tragic outcome in the case of a husky African native who underwent a simple hernia operation at the hands of a missionary doctor working among the Zulus On the third day after the operation he saw passing his hut a man with whom he had had a quarrel, he was convinced that the man would "invoke strong medicine" to work him ill No assurance of the surgeon could influence him "I'm going to die," he kept repeating—and die he did He passed out as a result of starvation and violent apprehension —scared to death

More and more our profession is invited and urged to consider the bearing of mental stress on bodily health The problem, as it presents itself to a clergyman "of a somewhat scientific turn of mind, although not a scientist," is the subject of an address delivered before the American Medical Association by Peale[79] at the installation of its president Physicians recognize that a long held mass of unhappy thoughts can produce physical symptoms of illness Man is soul as well as body, in the treatment of physical symptoms full effectiveness becomes more likely when the emotional or spiritual need is cared for In a cited instance the patient resented his physician's searching questions — "his morals had no relation to his physical condition' Wrong doing was finally brought to light and its rectification led to great improvement in the man's physical state In general caution is still indicated in the acceptance of non medical healing, but all realize that amazing phenomena do occur which are outside the framework of man's understanding

It would be interesting to know what reaction occurred in the minds of all those doctors The patient asks, "What does it mean—mind over matter?' Here we are on solid ground The popular word came to be "psychosomatic", when first used many patients thought it signified a new approach, was, in fact, a real discovery Of course, the only new thing was this word now applied to the old, well known relationship As physicians, we have always known that the mind is Captain of the Ship, the only new thing is that we are becoming better acquainted with the Executive Officer, the Hypothalamus It is a surprise to the patient when we tell him that we have had 5 000 years of *psychosomatic medicine.* Finally came the amazing medicine and surgery of the *body* which especially in the last fifty years, has resulted in longer life, a healthier race and a far better habitation for the soul of man

Current use of the word Stress has to do largely with such factors as anxiety or grief, which are not connected with laboratory experimentation Dubos[10] however, seeks to induce stress in mice by giving thyroxin or other chemical agents, or by withholding food for 36 to 48 hours The most effective way of lowering resistance to infection is to starve the animal for 48 hours, before inoculation with bacteria. He put one group of mice on a standard Sherman diet, a second on a diet low in protein and then on a starvation period of 48 hours. He injected bacteria and allowed ten hours to elapse, with the following results The well fed group showed sterile blood and a few organisms in the spleen and the liver the starved mice had bacteria in the blood and in very high counts in the same organs.

ALLERGY

The evidence that histamine plays a part in anaphylaxis is so strong that there is hardly anyone today who would have the temerity to deny it, but Gladstone[31] suggests that it is not the only factor concerned When histamine is injected into an animal the resulting condition of shock does present certain differences from anaphylactic shock One difference is the lessened blood coagulability due to the liberation of heparin from the liver, which is absent in histamine shock Shock produced by peptone is more like anaphylactic shock than that produced by histamine The main manifestations of shock can be accounted for by contraction of smooth muscle and damage to capillary endothelium Anaphylaxis, therefore, is a highly artificial condition brought about by the injection of a large amount of antigen directly into the circulation of an animal that has been sensitized There are certain natural diseases which differ from anaphylaxis in a number of ways but in which there is definite evidence of a similar underlying mechanism It is these diseases, mainly studied in man, that are termed "allergic."

In 1845 Wharton Jones described certain white blood cells of distinctive appearance, with double refractory granules Thirty-four years later Ehrlich described their identification with acid stains Since Ehrlich's day Samter[32] has estimated that close to 10,000 papers on this subject have been written, yet our knowledge of these cells, the eosinophils, is still deficient When their number in the circulating blood is decreased by ACTH or the hormones of the adrenal cortex, what becomes of those lost from the circulation? Why is the reduction in the count so consistently in the neighborhood of fifty per cent? We do not know Samter has demonstrated that lung tissue from sensitized guinea pigs can be transferred to normal pigs and effect an eosinophilia, he expresses confidence that an "eosinophilic factor" exists, though not yet discovered

The effectiveness of ACTH and cortisone in the treatment of asthma led Kuhne, Schmidt and Kania[33] to employ cortisone alone or combined with fever therapy in a series of forty cases Artificial fever was brought on by a turpentine abscess in thirteen, by injection of milk or a mixture of non-pathogenic bacteria in normal saline solution in fourteen, in the other thirteen cases, cortisone was given alone The combination of turpentine abscess fever and cortisone gave especially gratifying results, this was the more striking as the patients in this group were suffering from severe continued asthmatic spasm. Three cases were failures, but in general the tendency toward attacks was reduced The presence of eosinophilia proves lowered function of the adrenal cortex and calls for replacement therapy with cortisone

MINERALS

For the localization of brain tumors, Amyes, Deeb, Vogel and Adams[34] employ a radioactive isotope, iodine or phosphorus, and two kinds of Geiger counter The standard type of instrument is used in the diagnostic survey, and held in close proximity to the skull, the smaller, more sensitive scintillation counter is introduced into brain substance through a surgical opening, on some occasions a small burr hole. This latter instrument is a needle Geiger tube, 2 mm. in diameter, with a sensitive tip, it makes possible a localizing of neoplastic tissue with a minimum of damage to the brain The external approach has its limitations being of value for tumors in the cerebral hemispheres but not for those in the posterior fossa or the midline. The scintillation counter is brought into use in the first stages of surgery, in many cases it reveals the exact site and dimensions of the tumor Of fifteen cases of expanding intracranial lesions, its telltale click gave the needed information in fourteen, in the fifteenth case the lesion was an abscess

A long range study of the value of fluorides in the prevention of dental caries was begun seven years ago in the Passaic General Hospital Expectant mothers receive a fluoride during pregnancy, the child takes it later, until calcification of the permanent teeth is complete At the time of the birth, samples of blood are taken from the umbilical cord and the placenta, the fluoride content is calculated and checked against similar samples from "control" patients, who have received no fluoride except what happened to be in their drinking water The "cord blood' shows in the average pa tient a much higher fluoride content than is found in the "cord blood" of the *controls, by as much as 175 to 250 per* cent The placental blood likewise shows an increase, but in less degree Feltman and Kosel[14] present an interim report The study is *in* progress, and the final results will not be determined until the investigators can evaluate the resistance of the permanent teeth to decay

The role played by minerals in the human economy, a matter of interest to everyone, receives due attention from Davidson[15] The past decade has brought into great prominence the question What part has Fluorine in the prevention of dental caries? The fluoride content of foods must not be overlooked as a source of supply of this element, for example, certain baby foods with added bone meal may contribute a considerable amount. The answer is still to be determined In the matter of Iron, it is established that iron is bound by a specific globulin, beta-1 Once iron stores are depleted they apparently are rebuilt slowly, whether the source is food or medication A baby has adequate iron supplies for its first six months, but, if it is maintained on milk alone, it may develop an iron deficiency anemia Copper, in turn, is essential for the synthesis of hemoglobin, but our diets usually contain enough copper for our need Cobalt is an essential part of the "B12" molecule Lack of cobalt in sheep creates a deficiency preventing synthesis of "B12" and leads to severe anemia and weight loss Responses to cobalt and to "B12" seem to be similar, if not identical From animal experimentation Zinc is deemed a necessity for normal growth It appears to be related to insulin storage and activity

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CARCINOMA OF THE LARYNX CLASSIFICATION AND RESULTS OF TREATMENT *†

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With the advent of the new radiotherapy machines and their increasing use in clinical work, it has been considered advantageous at this stage to evaluate the results of treatment by the older methods Although so far there has been no definite evidence that the cure in relatively superficial lesions such as cancer of the larynx, is likely to be any greater with the newer types of radiotherapy[1], obviously some standard must be set in order that their true value may be estimated The results obtained by treatment with former methods of radiation as well as by surgical procedures are presented Such results will form a basis for comparison with newer methods

CLASSIFICATION

To the present day there is considerable confusion as to the classification of tumors of the larynx It is necessary, therefore, before going further to discuss this problem

Probably the most widely used system is one devised in the nineteenth century Krishaber[2] and Isambert[3] were responsible for the division of laryngeal tumors into *1* Extrinsic *2* Intrinsic, and *3* Subglottic groups. There is some difference of opinion as to which of these gentlemen was responsible for the introduction of the extrinsic group

The curious feature, however is that this system has survived so long, especially as it was conceived within two decades of the inception of the laryngeal mirror

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In order to discover just what the terms in this classification mean, the literature of various authorities has been reviewed.

The *Subglottic* group presents little difficulty. It is agreed that tumors in this group arise between the lower border of the cricoid and the under surface of the true vocal cord. They are notoriously "silent" for a long period and the prognosis usually is poor.

The *Intrinsic* group. There is a great divergence of opinion as to the extent of this group. The lower limit is generally accepted to be the free margin of the true cord, however, the upper limit varies considerably. Some take the true cord as the limit and use "intrinsic" and "cordal" as almost synonymous (Walsh,[4] Friedberg and Vollner), others take the free margin of the false cord (Hayes Martin), and some accept the upper surface of the vestibular fold (Negus)'

In the classification where "intrinsic" is applied to cordal lesions, "endolaryngeal" is applied to lesions involving the ventricle, ventricular bands, arytenoids, interarytenoid fold or crossing the anterior commissure.

Due to the difference in symptoms, degree of differentiation of tumor, rate of progress of lesion, and prognosis, it seems advisable to separate the cordal lesions from others arising within the lumen of the larynx.

The *Extrinsic* group. This term has been used to describe tumors invading the inner surface of the larynx above the very indefinite extent of the intrinsic group. In Walsh's classification it is applied to lesions arising superiorly to those in the "endolaryngeal" group. It is also applied to lesions on the outer aspect of the larynx, such as the pyriform sinus and postcricoid region.

On consideration of the physiology, histology, symptomatology and results of treatment it would seem essential to regard lesions of the upper aperture and outer surface of the larynx as pharyngeal rather than laryngeal. In recent years this has been the view of Baclesse[7] Cach, Hautant, Leborgne,[8] Lederman,[9] Lerou, Robert and Wilson

With this considerable confusion as to classification the anatomical sites of carcinoma of the larynx as described by the International Committee for Stage-grouping in Cancer and for the Presentation of the Results of Treatment of Cancer (referred to as I C P R) in Copenhagen in July, 1953, is extensively welcome The report of the committee has not yet been officially accepted, but is a guide to the modern out look on the problem by the radiotherapist Such a classification (Table I) also offers advantages to the surgeon

TABLE I

ANATOMICAL SITES OF CARCINOMA OF THE LARYNX I C P.R

Carcinoma of the Supraglottis
Carcinoma of the Glottis (Vocal Cords)
Carcinoma of the Subglottis
Carcinoma Occurring in Borderline Areas

The lesions in this fourth group 'arise at or near the upper border of the larynx in which on examination it is impossible to state accurately whether the original lesion began within or without the larynx Such lesions should be included with the pharyngeal carcinoma'

The group 'Carcinoma Occurring in Borderline Areas' is still rather vague Lederman[9] giving sound reasons had previously suggested that the epiglottis be divided into infrahyoid and suprahyoid portions growths involving the suprahyoid portion should be considered epilaryngeal tumors of the pharynx. Thus the supraglottic area includes the ventricle ventricular fold and infrahyoid portion of the epiglottis This puts a more definite limit to the supraglottic area and should reduce the number of cases being placed in that group ✓

STAGING

The staging as well as classification has been of various types but the I C P R method previously described by Leborgne,[8] is the one used in this series and is shown in Table II

TABLE II

CLINICAL STAGES IN CARCINOMA OF THE SUPRAGLOTTIS GLOTTIS AND SUBGLOTTIS (I S P R)

Stage I Carcinoma limited to the mucous membrane Full mobility of the larynx retained No nodes palpable

Stage II Carcinoma, infiltrating but not extending beyond larynx Mobility of larynx impaired or lost No nodes palpable.

Stage III Carcinoma extending beyond larynx, or nodes palpable but movable

Stage IV Involvement of skin, or nodes fixed, or distant metastases present

The term "mobility of the larynx" should be noted The obvious meaning, mobility of the whole larynx on deglutition or palpation is certainly not intended nor does it mean movement of the vocal cords in all sites In the supraglottic lesions it refers to the movement of the ventricular fold, in the glottic lesions, to movement of the vocal cord, and in the subglottic lesions it must refer to cord movement This latter is a weakness in the system but as this group is relatively small it is not very important Certainly this system of staging is an improvement on that previously accepted, the system of Nielsen[10] where the glottic lesions are adequately dealt with but the subglottic are arbitrarily allocated to Stage III and supraglottic lesions to Stage IV Thus in the Nielsen staging, results of treatment in Stages I and II give higher results because the unfavorable noncordal cases are excluded and the survival rates in Stages III and IV are raised by including the early non-cordal lesions with the advanced cordal cases

If some such scheme of classification and staging, as suggested by I C P R , was accepted internationally by both surgeons and radiotherapists it would lead to a more accurate presentation of results and comparison of results would be possible, further, results of relatively small series would be of value, as they could be summated to give numbers which could be evaluated on a sound statistical basis

TREATMENT

Surgery In this series the surgical treatment has consisted of

1 Biopsy excision
2 Laryngofissure
3 Laryngectomy
4 Radical neck dissection for metastatic nodes

It may be pointed out that endoscopic removal was performed only once, and gave over five years of freedom before recurrence Laryngofissure was the other conservative surgical procedure There were no hemilaryngectomies or other modifications In no case was a radical neck dissection performed prophylactically and only one patient suffered bilateral neck dissection The surgery was performed mainly by Drs Lindsay Perlman Schuknecht and Brunschwig

Radiation

1 Deep X ray
2. Neck mould collar (1 case)

Deep X-ray therapy has been given with machines generating 200-250 KV with H V.L of 1 0 1 5 mm Cu The time dose has been 5000-5500 delivered during 35 62 days and through 5x6-10 cm field

No cases were treated by the Finzi-Harmer fenestration technique, nor by endoscopic needling, nor by interstitial deep X ray of Lambert and Watson techniques Recurrences were treated by laryngectomy Treatment was carried out under the direction of Dr Carpender and Dr Hamann.

So far there is very little evidence that in actual fact super voltage machines or cobalt units will replace the standard 200, 250 or 500 KV X-ray machines in the curative radiotherapy of superficial tumors such as of the larynx, or if they do, the results will be no better, as cancer lethal doses are readily achieved by the older methods Reduced skin dosage and reaction is the only major advantage of the newer machines

RESULTS

The cases under review are a series seen in the University of Chicago Clinics up to December 31, 1949 These have, therefore, been observed, if alive, for at least five years

Not included in the series are cases which have been partially treated at other centers and those in which there has been death from other causes Those which have failed to return for examination or we have failed to contact, have been counted as failures as it has been assumed that they have died from the malignant lesion This latter condition does not tend to improve the five year survival rate The series consists of 47 cases of which a summary is presented in Table III

TABLE III

47 CASES UNDER TREATMENT BY SURGERY - RADIATION OR COMBINED

Classification	No	5 Year Survival	Per Cent
Supraglottic	11	6	54 5
Glottic	36	28	77 7
Subglottic	0	0	0

The number of cases in this series is considered still too small to give an accurate evaluation of treatment particularly when broken down into various sites and stages, but some observations can be made

Of 11 supraglottic cases, six gained five year survival or 54 5 per cent

Of 36 glottic cases, 28 gained five year survival, 77 per cent

There were no cases in the subglottic group

These overall figures confirm the well established fact that the prognosis of the glottic group is much better than that of the supraglottic group

The glottic lesions have been broken down into stages in Table IV

TABLE IV

GLOTTIC CANCER

Stages	No	5 Year Survival	Per Cent Cure
I	9	9	100
II	25	18	72
III	1	0	0
IV	1	1	100

The excellent results in Stage I glottic cancer are at once apparent.

Of nine cases in this stage nine gained five-year survival

There were 25 cases in Stage II and of these 18 attained five year survival, *i e* 72 per cent.

There was only one case in each of Stages III and IV and these, therefore, will not be studied further

It is to be noted that 70 per cent of cases in this glottic group were in Stage II

In Table V these nine cases in Stage I have been broken down according to the treatment received

TABLE V

GLOTTIC — STAGE I

Treatment	No	5 Year Survival
Surgery	3	3
Radiation	6	6
Combined	1	1
All cases to S	4	4

One patient treated by radiation had a recurrence at the end of six and one-half years and was then treated by laryngectomy He is alive and well at the end of 11½ years after diagnosis

On reviewing the results of treatment of the limited or Stage I glottic lesion by surgery and radiation at 11 centers throughout the world it was noted that there was considerable variation in the results obtained by both types of treatment[6 9 11 12,13 14 15 16 17 18 19]

The difference in surgical results may be mainly due to selection of cases Some surgeons may be particularly careful to do the conservative operation only on well localized unilateral lesions while others will tend to be more optimistic Likewise with radiation there is considerable variation which may be due to differences in experiences and technique

If we compare the average results of surgery with the average results of radiation therapy at these various centers we find that there was only 2 per cent in favor of surgery, 88 per cent against 86 per cent, gaining five year survival

In Table VI the glottic Stage II lesions have been broken down according to the treatment received, surgery, deep X-ray, or combined therapy

TABLE VI

GLOTTIC — STAGE II

Treatment	No	5 Year Survival	Per Cent
Surgery	11	8	72
Radiation	14	7	43*
Combined	10	7	70
All cases coming to surgery	20	14	70

* Two cases subsequently required laryngectomy thereby reducing the long term survival rate to 28 5 per cent

Of the 11 cases or 72 per cent undergoing surgery, that is to say laryngectomy, eight obtained five year survival In this series, one patient had a localized lesion of one cord which has caused reduced movement of the cord Endoscopic removal gave over five year freedom from recurrence A further period of five years has been gained by radiotherapy

If the 14 cases receiving primary radiotherapy are examined in detail, we find that there were six five-year survivals Two of these cases subsequently required laryngectomy and are alive and well at 10 and 16 years postoperatively While the five year survival rate was 43 per cent, the long term cure rate was 28 5 per cent in the cases receiving radiation only

Of the nine cases later subjected to laryngectomy six gained five year survival following surgery, thus of the 14 cases receiving primary radiation no less than 10 or 71 per cent eventually gained five year survival after secondary laryngectomy It should be pointed out that the Group II cases which were radiated were mainly a selected group in what may be called early Stage II Cases in late Stage II were recommended for primary laryngectomy

Of the ten cases which received one form of treatment followed by the other when the tumor failed to respond or where there was recurrence after months or years, no less than seven or 70 per cent gained five year survival after the second form of treatment.

If we examine all cases coming to surgery we find that of 20 patients, 14, that is 70 per cent, gained five year survival, which was approximately the same as that obtained in those receiving only surgery

From this experience, again remembering that it is only a small series in these early Stage II cases when there is doubt as to choice of treatment between radiation and laryngectomy, or when it is imperative to save the voice, although radiation does not give as good results as surgery in Stage II, it is fairly safe to give radiation first and treat by surgery later if there is a recurrence. The percentage of five year survivals after delayed laryngectomy appeared to be as good as though surgery had been undertaken in the first instance, and in addition the patients did not lose the possibility of retaining the voice, however, the responsibility of the laryngologist is greatly increased since it is up to him to discover a recurrence at the earliest possible date For this reason patients receiving this form of treatment must report frequently and direct laryngoscopy and biopsy must be undertaken on the slightest suspicion.

The I C P R method of classification has also been used in recent reports by Lederman[9] and Von K. Schärer[20] Treatment of glottic carcinoma. Stage II by radiation therapy by these authors gave five year cures in 35 and 53 per cent respectively By comparison the results obtained in our series were 43 per cent by radiation and 70 per cent by surgery of five year cures

Of the 11 supraglottic cases there was one in Stage I, four in Stage II, six in Stage III, and none in Stage IV

The overall five year survival percentage was 45 It is significant that 54 per cent of cases was in Stage III (see Table VII) as compared with 70 per cent in Stage II in the glottic group

TABLE VII

SUPRAGLOTTIC

	No	5 Year Survival
Stage I	1	0
Stage II	4	1
Stage III	6	4
Stage IV	0	0

The treatment used in the supraglottic cases is shown in Table VIII

TABLE VIII

SUPRAGOTTIC

	No	5 Year Survival
Radiation	9	2
Surgery	2	2
Combined	3	2
All coming to Surgery	5	4

It is seen that of nine cases treated primarily by radiation only two gained a five year survival, however, this group includes some cases considered to be inoperable The two cases undergoing surgery (laryngectomy) primarily both gained five year survival and of three having surgery following radiation two were five year survivals Due to the small number of cases in this group, it is impossible to examine the results of the two different forms of treatment in the various stages

While remembering that some of the radiation cases may have been receiving only palliative treatment the impression is gained that surgery offers more than radiation in this group at the present day with the help of the antibiotics and the improved techniques in neck surgery

CONCLUSIONS

The results attained at the University of Chicago Clinics along with those reported from other centers on the treatment of carcinoma of the larynx seem to warrant several conclusions In the Stage I glottic lesions, excellent results can be obtained by either radiation or surgery

In cases where the quality of the voice is an important consideration radiation offers some advantage over surgery, providing that the radiation is properly controlled and that there is a careful follow up to detect any recurrence

In the Stage II glottic carcinoma the results of surgery were better than those gained by radiation, however, as indicated there is a small group in the borderline between Stages I and II where radiation may be safely tried and surgery reserved for a possible recurrence

For some time now there has been a policy at the University of Chicago Clinics that in those cases which have passed from Stage I into borderline or early Stage II and where the choice of treatment lies between radiation and laryngectomy and no longer between radiation and laryngofissure or some other conservative surgical procedure, radiation is advised and recurrence is treated by laryngectomy In these cases radiation has given some good results When there has been a recurrence, laryngectomy has given almost as good five-year survival rates as though the case had been treated primarily by surgery This policy has had the advantage of allowing a certain percentage of such patients to retain the voice

In the case of the supraglottic tumor, the impression gained from this series is that surgery offers a better five-year survival rate than radiation.

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MASSETER MUSCLE TREMOR AN IMPORTANT FACTOR IN MANDIBULAR JOINT DYSFUNCTION *†‡

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A type of bilateral masseter muscle tremor occurs in a limited number of cases being studied as mandibular joint problems Those observed were readily differentiated from paralysis agitans and from senile tremor Absence of mask-like expression, hand motions, and other signs appeared to prove that these belong to the senile tremor class, however there is an age variation Unilateral masseter tremor belongs to the degenerative palsy group, which usually shows many other obvious clinical features Organic disease of the nervous system is absent in most cases of bilateral masseter tremor It seems to be either an isolated muscle phenomenon, or a fraction "of oral (facial, lingual and masticatory) movements, including both spasms and tremor on a functional or psychogenic basis initiated at the subconscious level"[1] (Kempinsky)

It may not be observed at once, but may be detected by palpation with each thumb firmly pinching into the anterior border of each masseter muscle, with the patient's mouth closed Pulsation of the facial artery is noted as synchronous with the pulse. The tremor averages about three oscillations per second it slows under pressure of the thumb, and when palpated a moment later, has resumed a rhythmic rate It will sometimes disappear when the patient relaxes, and returns under tension or interest

The patient with masseter tremor describes vague dull aching of the jaws, otalgia, and other reflections of pain

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CHART I TABULATION OF CLINICAL FINDINGS IN PATIENTS WITH MASSETER MUSCLE TREMOR

Patient	General History	ENT and Neuralgia History	Neurological Survey	Treatment	Course
Case No 1 G P Age 42 Female 3 25 54	Appendectomy at age 13, cholecystectomy at 23 herniorraphy at 34 benign masses removed from ovary (L) at age 39	Treated as eye problem 1950 to 1953 Otalgia (L) and trismus since extraction of molar teeth 1 year ago	Dr J O'Leary (1) 4 15-55 tmj syndrome (2) chronic anxiety (3) no neurological disorder (4) bilateral masseter tremor 3 cycles per second	1 14 55 occlusion balanced nine months entirely relieved, now has occipital and parietal headache (L) 5 20 55 dental overlays removed, symptoms the same 6 10 55 left tmj injected with 25 mgm hydrocortisone	Relieved nine months by balanced occlusion overlays removed, much relieved of otalgia (L) by injection of hydrocortisone Glossodynia (L) for three days following injection
Case No 2 N F Age 52 Female 9 25 54	Third molar extraction 1950 mild hypertension	Four changes of partial dentures in six years, each change good for a time then teeth strike at odd angles numbness in tongue, cheek (R) tinnitus (R) masseter tremor bilateral	Dr Kempinsky (1) contractions of facial, lingual, and masticatory muscles, at times associated with sternomastoid and platysma contraction (2) no masseter tremor noted (3) complete neurological entirely negative no evidence of pseudobulbar palsy Impression motor neurosis or oral and facial tic probably psychogenic	Elastic jaw splint. Ability to arrest contractions when resting	Improved by reduction of activity at work use of elastic jaw strap and courses of B12 injections All symptoms remain

CHART I TABULATION OF CLINICAL FINDINGS IN PATIENTS WITH MASSETER MUSCLE TREMOR (Cont.)

Patient	General History	ENT and Neuralgia History	Neurological Survey	Treatment	Course
Case No 3 S D Age 49 Female 1 31-51	Negative for major illness.	Extractions 1950 full dentures tremor in jaw muscles started three months later can be controlled by chewing gum.	Dr Kempinsky Gross and uneven tremor of masseters pursing of lips tongue movement, no sucking neurological entirely normal no pseudobulbar palsy Impression masseter tremor is part of involuntary oral movements not autonomous muscle fasciculations can arrest them by relaxing and has deep anxiety factor	Elastic jaw splint therapeutic B complex by mouth.	Symptoms remain, but improved on elastic splinting, mild sedation and high vitamin therapy
Case No 4 P L Age 61 4-1-54 Female	Gastric studies B H 1948 domestic trouble basis of complaints. Treated for anorexia in general medicine to date Subtotal gastrectomy for ulcers 1950 B H	Teeth extracted 1945 15 sets of dentures since Jaw problem treated in plastic surgery 1950-51 no denture ever worn with complete comfort. Otalgia bilat. Glassodynia rt.	Masseter tremor thrusts tongue sideward to left, preventing denture to remain in place Psychiatric care 1949 no neurological change.	Elastic splint attempted cannot wear it. Anti magnetic dentures used unsuccessfully Seaver s myotonic exercises gave most relief	On last visit 8-26-54 attempt to splint jaw was stopped Seaver s exercises to continue.
Case No 5 V P Age 78 Female 4 22-54	Ostructive emphysema three years bronchial asthma, intrinsic.	Removal of nasal polyps four times in five years Otalgia increased on coughing. Edentulous, jaws tire and plates "feel too full"	Fine tremors of masseter muscles and tongue. No neurological exam. made.	Elastic splint to jaws 2 mm. cork between molars bilateral	Elastic to jaws completely relieved her prefers to wear strap almost all the time

CHART I TABULATION OF CLINICAL FINDINGS IN PATIENTS WITH MASSETER MUSCLE TREMOR (Cont.)

Patient	General History	ENT and Neuralgia History	Neurological Survey	Treatment	Course
Case No 6 I S Age 54 Female 8-26-54	Left condyle of mandible excised for cystic disease April 1946	Otalgia, right, ever since resection of (L) condyle Film shows impaction of right condyle upward	None made Fine masseter bilateral tremor	Elastic fixation of jaw with 4 mm cork within left side	Elastic splint with 4 mm cork with (L) side for short periods, entirely relieved, continue strap
Case No 7 C O'M Age 70 Female 11 18 54	Mucous colitis Visual disturbances, rated hypochondriac.	Otalgia, bilat. six years pain radiates to neck and face Most pains worse left. Films show widened flat glenoid fossa, left.	Brown Sequard phenomenon (L) meningioma sixth thoracic spine, surgery refused 7 9 54 bilat masseter tremor, fine	Elastic splint with 2 mm cork (R) refused use of strap pressure, too painful to face	Refused management of obvious malocclusion Returned at intervals to ENT clinic for "headache" up to 6-21 55
Case No 8 W M Age 80 Male 8 5 54	Remarkably negative medical history	Pulsating sensations in rt ear two and one-half years no dentures worn, referred to dental clinic, narrowing of tmj and arthritis is present bilat.	No neurological done Audiogram shows advanced VIII nerve deafness rt Fine tremor in tip of tongue and masseter muscles	Elastic splint to be used on new dentures, one-half hour periods each day	Elastic restful, uses it more than prescribed to 1 21 55
Case No 9 W L. Age 85 Male 8 5-54	Hypertensive vascular disease Emphysema enucleation right eye	Pain in right side of face five years, typical of trigeminal neuralgia, strap gives comfort Masseter tremor fine bilat	Complete neurological exam at time of trigeminal neuralgia operation showed only senile fasciculations and trigeminal neuralgia right	Elastic strap with 2 mm separation right Refer to neurosurgery operations for rt trigeminal neuralgia 2 23 55	Improved except for acute urinary retention and sequelae

CHART I TABULATION OF CLINICAL FINDINGS IN PATIENTS WITH MASSETER MUSCLE TREMOR (Concl.)

Patient	General History	ENT and Neuralgia History	Neurological Survey	Treatment	Course
Case No. 10 J B Age 72 Female 3 25-55	Negative except for eye problems.	Nerve deafness 40-50 deb bilat. Otalgia increased during eating Crepitus in tmj bilat., tender to palpation.	Dr Kempinsky contractions of facial muscles mild pursing of lips fine tremor of extended hands protruded tongue and masseter disease of nervous system.	Elastic splint to jaws for one-half hour periods with dentures in mouth	Entirely relieved of otalgia by elastic splinting. The strap is restful when jaws are tired.
Case No 11 A. McC Age 56 Female 4 15-55	Cortisone treatment of arteries in 1954 quivering of face began while in hospital gave her speech impediment. Improved on voice therapy divorced has serious domestic problem.	Only catching and stopping of lower jaw on speaking or biting Speech difficulty	Dr Kempinsky orofacial tic, masseter tremor psychoneurotic disorder conversion type	Elastic splint to jaws with 2 mm. cork bilaterally Psychiatric treatment, medicine D	Chewing much improved uses strap shortly before eating on 5-20-1955 reported improved by psychotherapy
Case No. 12 J J Age 37 Female 2 16-55	Negative.	Coagulation rt labyrinth for vertigo 10-8-1954, Dr Theo Walsh Occipital headache, cannot wear new dentures because of nervousness. Tmjs tender to palpation masseter tremor bilateral.	Dr R. J Mueller masseter tremor no neurological change. Referred to psychiatry for depressive state.	Elastic splinting of jaws with new dentures in place.	Splinting of jaws restful to her masseter tremor remains, still under psychiatric care.

typical of mandibular joint disease If old dentures are worn, they are described as loose and difficult to hold in place With adequate new dentures the patient describes excessive tiring, and one or both dentures are left out of the mouth at intervals *This applies only to cases with the status of permanent tremor* The tiring and tremor which begins with insertion of new dentures lasts a few days and subsides, is due to the "stretch" reaction This reaction is the basis of clonus "If a rapid stretch is forced upon a muscle, an outburst of afferent activity results in a cycle of motoneuron responses in large numbers in step with each other A series of clonic responses gives thus a tremor effect included in this are the elevators of the lower jaw"[2] Further, in the presence of masseter tremor, when occlusion is balanced with partial dentures, striking of teeth unevenly is described after apparent perfect restoration If this is corrected, relief is obtained for a short interval, then striking begins on the opposite side

In this series of 22 cases, 19 are female, and three are male, ages ranging from 37 to 85 years Twelve are briefed in the chart The remaining ten cases are either duplications or exclude one multiple sclerosis and one pseudobulbar palsy All have, without exception, a psychogenetic overlay, as suggested by Dr Kempinsky It is important to separate the muscle tremor group from those with a background of supranuclear palsy In the latter, occlusion cannot be sustained, dentures cannot even be held in the mouth, degrees of discomfort cannot be determined These begin with speech difficulty and ejecting of the lower denture with the tongue There is unilateral fine masseter tremor They progress into the hopeless stages of reflex contractions of mouth and masticatory muscles, also, conversion neuroses may not be included here, because pain descriptions are unreliable

Treatment is symptomatic, reliance being mainly placed upon elastic splinting of the lower jaw By simple mechanical support, this seems to relieve the muscle fatigue produced by masseter tremor Psychiatric investigation is being carried on in selected cases and may provide a solution for some of the problems Routine palpation of the masseter muscles is essential to early observation of this condition

SUMMARY

We are not so much concerned here with identifying the pain effects incidental to the mandibular joint syndrome, as with directing interest to an important muscle incoordination Masseter tremor may be obscure when not noted in connection with facial and oral movements, it may occur as an isolated phenomenon It is not fibrillation nor fasciculation, nor simple muscle spasm.

The distinction between phases of oral and facial palsies which also include masseter tremor is not easy to define clinically, and actually is unnecessary, however, recognition of masseter tremor, not accompanied by other facial movements, is extremely important, completely controlling the prognosis in cases being treated for any type of mandibular joint disorder

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THE VIRGINIA SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY CONVENTION CRUISE

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CLINICAL EVALUATION OF PRESBYCUSIS ON THE BASIS OF DIFFERENT TESTS OF AUDITORY FUNCTION

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and

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The otologist who deals with elderly, hard-of-hearing patients knows how severe the hearing disability of his patients can be, even when the overall amount of hearing loss is not very great He knows, furthermore, that two individuals with the same amount of hearing loss for pure tones can differ significantly in their perception for speech

The present investigation is a study of the results of different tests of auditory function in a group of elderly, hard-of-hearing individuals This study is an attempt to determine, by psychophysical measurements, medical history and findings, whether or not it is possible to improve differential diagnosis of those hearing losses which at present are included under the generic term of *presbycusis* This term does not relate to the location of the lesions in the auditory apparatus, or to the factors responsible for the deterioration of hearing We know from studies of previous investigators, and particularly from those of Crowe, Guild and Polvogt[1], and of Fieandt and Saxen , that old-age alterations in the auditory organ can be caused by different forms of disease in association with different histological lesions and pathogenesis

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PATHOLOGY

According to Fieandt and Saxen[2], the two most common auditory lesions are senile atrophy of the spiral ganglion cells and angiosclerotic degeneration of the inner ear Senile atrophy of the ganglion cells is generally an independent and self-contained phenomenon where the alterations i e, atrophy of the ganglion cells and of the nerve fibers, affect chiefly the proximal parts of the cochlea The organ of Corti and the blood vessels are usually not included in the process

The angiosclerotic degeneration of the inner ear, on the other hand begins histologically as a vascular disease When there are lesions in the epithelium of the stria vascularis, it is possible to find marked changes in the cochlear duct, apart from a degeneration of the organ of Corti In more advanced cases, the supporting tissue is also included in the pathological process, which is characterized by sclerosis or homogenization of the connective tissue and rarefaction of the bone tissue The fibers of the auditory nerve are not attacked first by this process and the changes occurring therein are only secondary

Histologically, the atrophy of the neural elements in the cochlea corresponds to the clinical picture of presbycusis Angiosclerotic degeneration of the inner ear alone does not produce, primarily, any important functional disturbances in the acoustic apparatus Auditory function seems to be well-preserved in fairly advanced cases Fieandt and Saxen[2], indicate that presbycusis may also have its origin in lesions which perhaps develop in old people on an arteriosclerotic basis in the central acoustic pathways and centers These lesions are seldom the only reason for the defect in hearing since in most cases they are also combined with a senile atrophy of the spiral ganglion cells and of the nerve fibers The possibility of a central basis for the auditory defect should be taken into consideration when in addition to the clinical picture of presbycusis there is found a considerable deterioration of hearing for lower tones

According to these views supported also by the observations of Crowe Guild and Polvogt,[1] it does not appear that vascular lesions alone can be responsible for extensive damage to the organ of Corti Very severe lesions of the stria vascularis were found without apparent damage to the organ of Corti This fact has been confirmed clinically by Bunch,[34] who found that the average hearing loss in patients with arteriosclerosis, hypertension, chronic cardiac conditions, syphilis and malignant conditions is not greater than the hearing loss in groups of individuals of the same age in good health

Similar conclusions were obtained by Riesco-MacClure,[5] who found that neither clinical nor histopathologic differentiation was possible between senile hypacusis, progressive hypacusis of unknown origin in young persons, and hypacusis due to degenerative atrophic neuritis in the cochlea Riesco-MacClure believes that cochlear alterations occurring with old age are not due to vascular changes, but result from a degenerative and atrophic neuritis

This brief review suggests that different lesions in different locations can be responsible for those hearing losses which are subsumed under our present clinical concept of presbycusis The literature is rich in descriptions of pathologic changes in the cochlea believed to be associated with aging, but many of them, as Covell[6] states, may be due to artifacts of fixation or postmortem autolysis, and there is also the possibility that other important features in these observations on human temporal bones may have been overlooked

It has been pointed out previously that lesions responsible for hearing loss with age may be located in different parts of the auditory apparatus, namely, in the hair cells of the organ of Corti, in the spiral ganglion cells, in the nerve fibers, and in the central pathways It is difficult to identify the most common locations We can say that hearing loss in old age is a specific degenerative process with which different parts of the auditory mechanism may first be associated, and that the spiral ganglion cells and the peripheral nerve fibers are probably among the first to reveal changes

HEARING TESTS

We were primarily concerned with the possibility of differentiating the various types and locations of the lesions that produce deafness in old age on the basis of psychophysical measurements In other words, could we find some audiometric criteria to help us make a differential diagnosis?

A representative sample of elderly individuals was obtained from the files of the past two years of the Hearing Clinics at Central Institute for the Deaf These contained extensive information on about 1500 individuals who had received hearing tests and hearing aid evaluations The records consisted of a case history, audiogram for air and bone conduction, mon aural speech reception threshold (spondees), monaural maximum discrimination score, binaural field threshold for sentences, measurements of the patient's performance with several hearing aids and an otolaryngological report (where this was not completely available, a subsequent examination was carried out by one of the authors—G P)

From these records a group of cases was selected that could be tentatively classified as presbycusis, according to the following criteria of evaluation

1 Otolaryngological report negative for otoscopic and rhinoscopic findings and for previous ear diseases

2 Case history negative with respect to previous severe diseases

3 Sixty years of age or older (the range was from 60 to 90)

4 Audiometric indication of perceptive type hearing loss

5 Pure-tone audiogram curve not exceeding a gradually increasing loss for higher frequencies (only in 20 cases did the slope exceed 20 db per octave)

6 Onset of deafness gradual and progressive, less than 10 years before the test.

7 Bone conduction almost equal to air conduction

8 Profile of right and left ear air conduction almost equal and not differing by more than 15 db at any frequency (When the difference between the two ears was more marked we considered this an indication of some contributing factor other than presbycusis.)

9 Average hearing loss for pure tones (500 2 000 cps) between 10 and 60 db (75 per cent of the cases have a hearing loss of between 25 and 45 db)

Only 185 cases met our criteria

We tried to retest those subjects who resided in the St Louis area and to do additional diagnostic audiometric tests Of 70 persons in this category, only 24 could come back for a retest On these subjects we carried out the following tests which lasted about two hours

1 Short structured interview, particularly concerning past medical history

2 Otolaryngological examination for the subjects who had not had one

3 Pure-tone audiogram for air and bone conduction, to find whether the hearing loss had increased

4 Recruitment test (*Reger technique of monaural loudness* balance between different frequencies)

5 Monaural threshold for spondees and monaural maximum discrimination score for PB lists, for test-retest reliability

APPARATUS AND MATERIAL

Pure-tone audiograms were obtained with a Maico H-1 audiometer A block diagram of the equipment used for speech audiometry is presented in Fig 1 Hearing loss for speech was measured with the Harvard Psycho-Acoustic Laboratory Test No 9[7] spondee word lists, a set of recordings of spondaic words whose intensity decreases progressively Speech discrimination scores were obtained by presenting phonetically balanced lists,[8] each consisting of 50 monosyllabic words, at a relatively high level Usually, speech discrimination score was measured at a level 40 db or more above the patient's threshold for speech. When the patient could not tolerate a high sound pressure level, a lower level was used Threshold for sentences was obtained by means of Harvard Psycho-Acoustic Laboratory Test No 12,[7] a set of recordings of short, relatively easy sentences This test was done in the field, and another threshold for sentences was obtained when testing the performance with a hearing aid

The equipment diagrammed in the middle of Fig 1 was used for monaural loudness balance test The basic unit is an electronic two-channel switch. Each channel was fed by a different audio-oscillator, and a mixing network delivered the two tones to the same earphone Each tone was about one second long, with a moderately rapid but clickless rise and fall The output of Channel 1 was alternated with that from Channel 2.

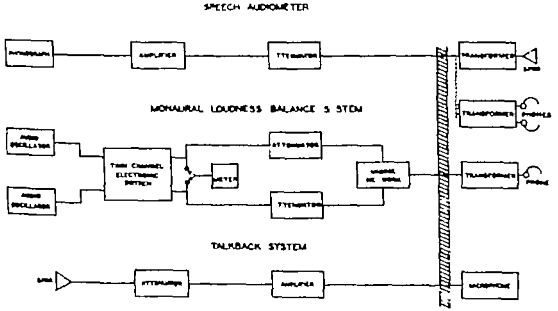

Fig 1. Block diagram of apparatus for speech audiometry and monaural loudness balance test.

The monaural loudness balance between different frequencies[9] was chosen as the only test for recruitment available for our particular purpose. As a matter of fact, since most of our subjects had practically the same amount of hearing loss for both ears (not exceeding 15 db difference between the two ears at any frequency) we could not use the usual Fowler[10] technique that requires not less than 25 to 30 db difference between the two ears to give consistent results The various DL-test techniques (Lüscher[11] test and modifications Denes and Naunton[12] and modifications) were considered but were not selected as routine tests for several reasons chiefly on the basis of the results of Hirsh Palva and Goodman[13] In an experimental study based on 44 patients with a variety of types of hearing loss and 18 normal subjects, they showed that the difference limen cannot distinguish recruiting and non recruiting cases nor can the difference limen distinguish hard-of-hearing listeners from normal listeners, when the DL is measured with discrete tones at sensation levels of 5, 25 and 40 db Since negative results have also been reported by others (Lidèn and Nilsson,[14] Lund-Iversen[15]), and inasmuch as these negative results were in agreement with our own experience, we decided to utilize only the above-mentioned Reger[9] technique

The testing procedure was usually the following The frequencies to be matched in loudness were selected according to the pure-tone audiogram, so that the patient matched the test frequency with a reference frequency at which the hearing loss was less than 25 db We avoided any matching of frequencies more distant than two octaves For instance, if a subject had 15 db hearing loss at 500 cps, 25 db at 1,000 cps, 40 db at 2,000 cps, and 55 db at 4,000 cps, the balance was made by matching 500 cps and 2,000 cps If a subject had 15 db hearing loss at 500 cps, 15 db at 1,000 cps, 25 db at 2,000 cps, and 45 at 4,000 cps, the balance was made by matching 1,000 cps and 4,000 cps In other cases 500 cps was balanced against 1,000 cps or 1,000 cps against 2,000 cps Frequencies of 500 and 4,000 cps were not matched because it was found that the judgment was too difficult for most subjects

In cases where there was a hearing loss of more than 25 db, even for low frequencies, it was more difficult to demonstrate the presence of recruitment In these cases both impaired frequencies may have had recruitment For this reason, when the hearing loss was more than 25 db for all frequencies, we took into account only positive results indicating the presence of recruitment Negative results we considered merely as doubtful However, only four out of our 24 cases were in this category, and taking into consideration the threshold of pain and sharpness of response, it was possible to decide qualitatively whether or not recruitment was present

Testing procedure was as follows After having established the threshold for the selected frequencies, one of the tones (usually the higher) was set at 20 db above threshold, at this time the second tone was introduced in the same ear through the circuit of the electronic switch, so that two alternating tones of one second duration each were heard by the patient. The subject was asked to tell if the "low" or the 'high' tone sounded louder any time the intensity of the second tone was varied After several measurements (usually not less than 10 or 12), balance was obtained The same measurements were repeated at 40 db above threshold and at 60 db or more, according to the hearing loss of each patient at the tested frequencies

RESULTS AND DISCUSSION

All of the available data were analyzed and separated into two different groups A first series of data includes the relations between pure-tone tests and speech tests among the total group of 185 old individuals as taken from the record files of the Hearing Clinics The second series includes the relation between recruitment and discrimination score in the smaller group of 24 individuals who came back to the Clinics for the retests described above

We emphasize that our sample of patients was 'selected" It included, in fact, a group of individuals who came spontaneously to the Clinics or were referred by otologists, hearing societies hearing aid companies, etc. In other words, this investigation was not concerned with a random sample of old people regardless of the hearing disability of the subject, but with a selected sample of old people who came to the Clinics because they complained of being hard-of-hearing For this reason, a comparison between our cases and the cases of some preceding World's or State Fair (New York, San Francisco, San Diego and more recently Wisconsin) is not feasible

Fig 2 shows the relation between hearing loss and discrimination loss in the total group of 185 individuals The solid line represents such a relation, on the abscissa the mean hearing loss for pure tones (500 2,000 cps) for 370 ears is indicated On the ordinate discrimination results are plotted in terms of discrimination 'loss" instead of discrimination 'score" The dotted line represents the same relation when considering the

of a mild hearing loss, and became more severe as hearing loss increased The fact that poorer discrimination in old people is associated with a greater amount of loss has already been observed by Gaeth,[14] who, in a study on phonemic regression, found that in two groups of individuals with a discrimination "score" better than 69 per cent, the mean hearing loss was between 35 and 39 db, whereas in the group of individuals with poor discrimination (score below 68 per cent), the mean hearing loss was 51 db

Gaeth says 'The most obvious interpretation is that phonemic regression seems to accompany more severe hearing loss In such an event, the two deficiencies might have a common cause On the other hand, it is possible that when a hearing loss reaches a certain degree of severity, phonemic perception is more easily disturbed If this is true good phonemic perception associated with severe perceptive loss may be rather exceptional" Gaeth feels, however, that an alternative interpretation is more tenable namely, the importance of selective factors that were instrumental in bringing patients to the Clinics In any event, the fact that poorer discrimination is associated with greater amount of hearing loss seems undoubtedly to be the case among this group of old individuals

In order to verify this statement in other groups of individuals, we picked from our population all the individuals on whom the case history revealed the presence of some other possible contributing factors This group was rather small, including 29 individuals 18 with cardiovascular disorders and hypertension eight with familial history of deafness, and three with metabolic diseases (diabetes) or chronic drug intoxications Fig 3 shows that the lines representing the function of the total group and of the sub-group of individuals with positive medical history have a certain amount of overlapping, and that only the groups with an average hearing loss of 35 db show a wide difference probably due to the small number of individuals (four) in the "clinical' group with this amount of hearing loss

The comparison between a group of old people in good health and a group of individuals with cardiovascular dis-

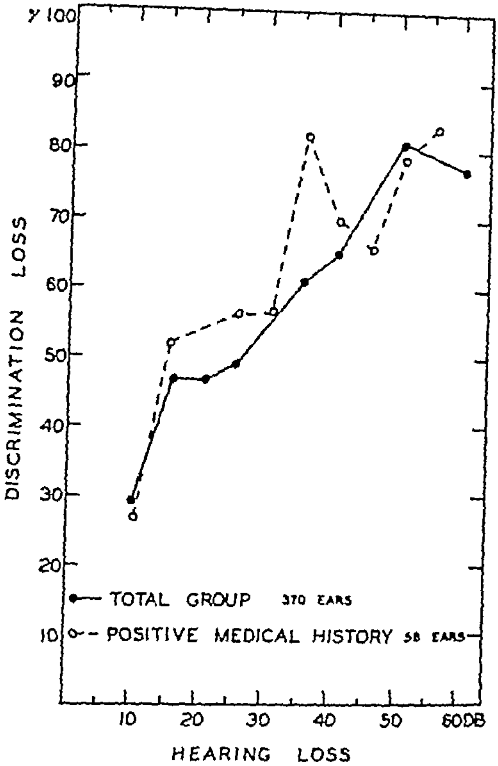

Fig 3 Relation between discrimination and hearing loss in total group and in a sub-group showing positive medical histories

orders, hypertension, familial history of deafness, and metabolic diseases, does not show a significant difference insofar as the relation between hearing loss and discrimination loss is concerned Although the necessity for further more extended study is suggested, these results seem to confirm, even though considered from a different angle, Bunch's[3, 4] findings, that health conditions do not influence the amount of hearing loss in people of the same age group

Another interesting relation is revealed from the study of a second group of individuals selected from the files of the Hearing Clinics It was our purpose to find the relation between hearing loss and discrimination loss in a group of young people, in order to ascertain whether or not the phenomenon of poorer discrimination associated with greater amount of hearing loss in a phenomenon peculiar to old age

A group of young individuals was selected according to the following criteria *1* hearing loss of the perceptive type, with bone conduction almost equal to air conduction, *2* air conduction curve of the "gradually sloping' type, showing a great similarity to presbycusis curves *3* overall average hearing loss for pure tones in the same range as the group of old people, *4* not more than 40 years of age, *5* onset of hearing loss not before 20 years of age, in order to be assured that these individuals had acquired normal development of language during childhood Only 25 individuals met all the requirements They had different types of hearing losses, and the clinical diagnosis according to the medical history and type of hearing loss, was possibly the following

Heredity three cases

Neurologic diseases, vertigo two cases

Hearing loss as a result of infectious diseases four cases

Traumatic deafness five cases

Intoxication (quinine) one case

Unknown origin (not enough information from the medical history to make a positive diagnosis) ten cases

It can be seen that these few individuals are representative of very different types of hearing losses There was no measure of recruitment in the records but it is known that most hearing losses due to the above-mentioned causes are of the recruiting type Furthermore, it is assumed that recruitment makes discrimination worse (although this is not necessarily true), but certainly not better

From the analysis of Fig 4 it may be noted that *1* Poorer discrimination associated with a greater amount of hearing loss also was present in the group of young individuals, although with less evidence *2* discrimination gets worse as the hearing loss goes from 10 to 30 db but is still at the same level at 45 and 50 db hearing loss after a sudden elevation at 40 db *3* discrimination loss was definitely less in the group of young individuals as compared with old individuals with the same amount of hearing loss Although the number of young individuals was smaller, the comparison between the curves

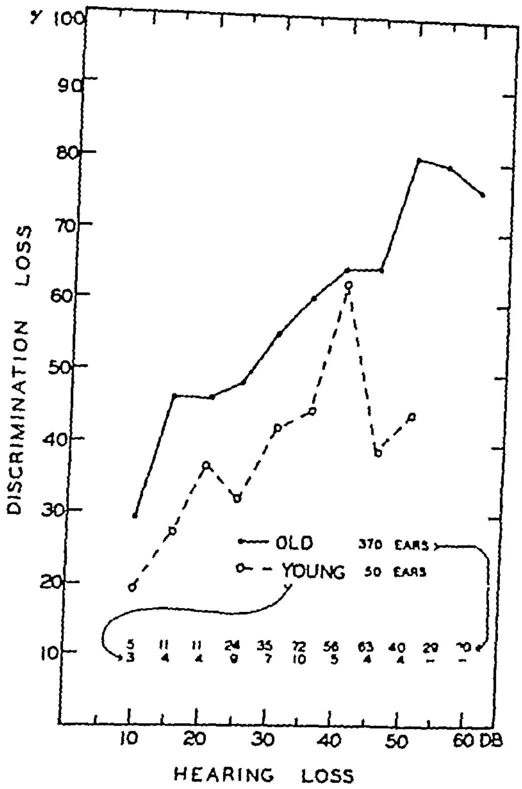

Fig 4 Comparison of relations between discrimination loss and hearing loss in a group of old patients and in a young group with similar losses.

seems to be quite suggestive, discrimination in young people was always from nine per cent to 20 per cent better than that of the old people with the same amount of hearing loss (except at 40 db, where it is only three per cent better), and becomes almost 40 per cent better when the hearing loss is 45-50 db

These findings seem to be a fairly good confirmation of Gaeth's[16] findings on "phonemic regression" According to this author, the phonemic-regression syndrome includes the following features *1* It exists under the guise of a perceptive type hearing loss, *2* it may be more prevalent in moderate to severe hearing loss cases, *3* it has no presently known cause, *4* it represents a reduction in the ability to hear and to repeat common words at all supra-threshold levels, *5* it appears to be associated with a corresponding reduction in pitch discrimination ability,[6] it may be complicated by low vocabulary scores

As a comment on our findings, it is worthwhile to point out how the ability to understand speech is substantially lower than would be expected from the audiometric scores of our population The phenomenon of phonemic regression, reported by Gaeth, substantiates this finding Although associated with the overall amount of hearing loss even in young people, phonemic regression seems to be more clearly related to age It is difficult to tell which pathologic phenomena are at the basis of these findings, *i e*, whether end-organ or central pathways are involved. We did not perform any tests of

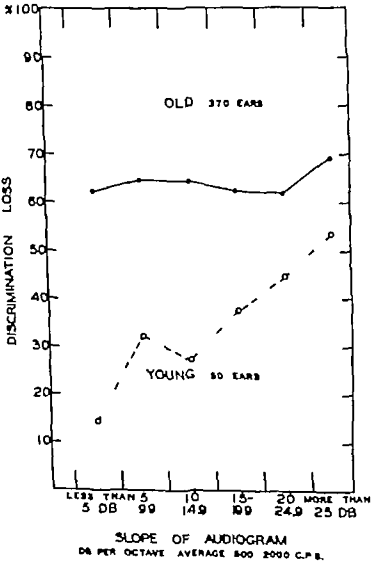

Fig. 5 Relation between discrimination loss and slope of the audiogram for group of old patients and for the young group

intellectual functioning with our subjects, as Gaeth did (CVS tests, critical fusion frequency test, cancellation test, time reaction test) These tests, in Gaeth's population, did not show any significant deviation from the normal, even in the subjects with a very poor discrimination score Apparently, among those subjects showing a phonemic-regression syndrome, we do not have signs of decrease of intellectual functioning to explain the poor discrimination score

The relation between the slope of the audiogram and discrimination loss is shown on Fig 5 On the abscissa, the slope is indicated as an average of the slope (db per octave) occurring between 500 and 1,000 cps and between 1,000 and 2,000 cps In the group of old individuals, discrimination loss seems to be independent of the slope of the audiogram In fact, discrimination is always very poor (ranging from 62 per cent to 64 per cent loss) in different groups with a slope less than five db per octave up to 24 9 db per octave Only individuals with a very steep slope (more than 25 db per octave) seem to have a slightly more severe discrimination loss (69 5 per cent) In the group of young individuals, the function is different, there is a clear indication that discrimination gets worse as the slope increases

Another relation which emerges from our data concerns the results of speech tests in relation to pure-tone tests The hearing loss for spondees, available in 97 out of 185 individuals was related to the average hearing loss for pure tones (500-1,000 cps and 500-1,000-2,000 cps) and the difference between speech and pure-tone hearing loss for each subject was calculated This difference has been related to two other factors, *i e*, slope of the audiogram and discrimination loss

In Fig 6 the abscissa represents slope of the audiogram, and the ordinate represents the difference between hearing loss for spondees and for pure tones, positive numbers mean pure tones "better" than spondees, whereas negative numbers indicate pure tones "worse" than spondees Standard deviation ranges from 5 2 db to 8 8 db It is interesting to note that only in those patients with steep slopes of the audiogram (more than 20 db per octave) is there good agreement between pure tone (average 500-2,000 cps) and spondees. When the audiogram is flat (less than 5 db slope per octave), or mildly sloping, the spondee hearing loss is greater than can be predicted from the average 500-2,000 cps.

It is interesting to compare our results with Carhart's[17] findings in a group of 382 individuals. He found that the range of different scores was great within every group representing different audiometric profiles (flat, gradual high tone loss, marked high tone loss, notched beyond 2,048 cps, atypical, unselected). The standard deviations for the various groups were between 9.8 and 13.8 db. Nevertheless, for a given group the mean loss in speech reception is numerically very nearly equal to the "better ear" average for 512-2,048 cps. The only exception concerns the group of individuals with marked high tone loss, where the mean hearing loss for speech is 42.4 db and the mean for pure tone average is 48.8 db. This indicates that individuals with a marked high tone loss, generally speaking, have a smaller loss for speech than can be predicted from the audiometric curve with the usual methods. Our population, as we mentioned above, deals with individuals with gradual high tone loss, but also includes some individuals with more marked high tone loss.

It is interesting to note that in our population the correlation between pure tones (average 500-2,000 cps) and speech hearing loss as a function of the slope of the audiometric curve points in the same direction as Carhart's[17] findings. The only difference is that among our population of old individuals, pure tones and spondees are almost the same when the slope of the audiogram is steeper and pure tones (av. 500-2,000) are "better" than spondees when the audiogram is flat or more gradually sloping. For this reason we tried to correlate hearing loss for spondees with pure tones average 500-1,000 cps only. The solid line of Fig. 6 indicates that in this way the discrepancy between spondees and pure tones becomes even greater. The function goes in the opposite direction from the case of the average 500-2,000, the steeper the slope, the greater the difference between pure tones and spondees.

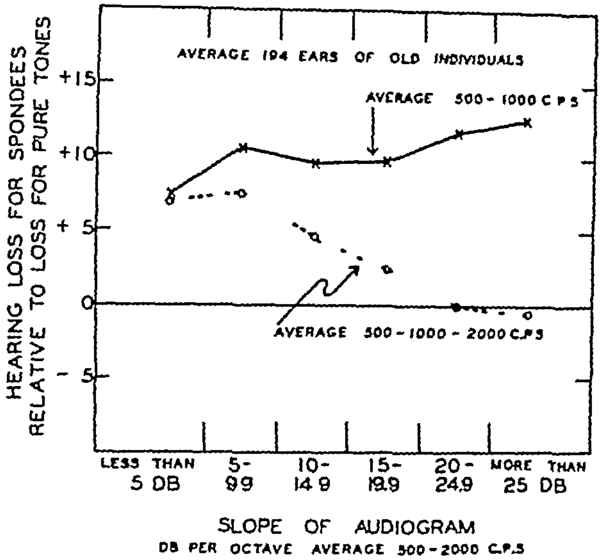

Fig 6 Difference between hearing loss for spondees and for pure tones as a function of slope of the audiogram for a group of old individuals

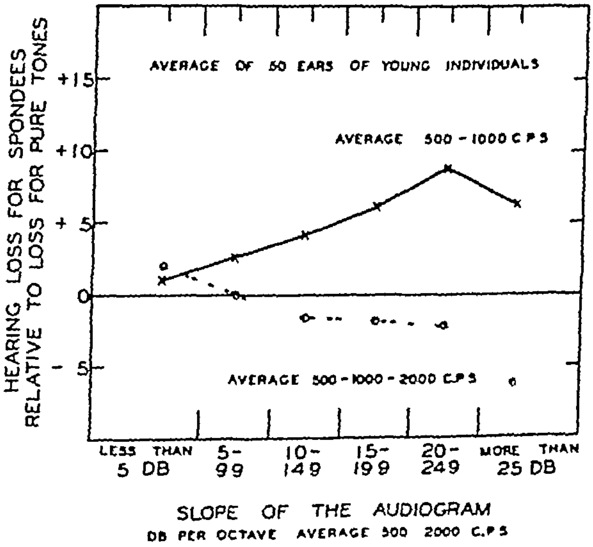

Fig 7 Difference between hearing loss for spondees and for pure tones as a function of slope of the audiogram for a group of young individuals

According to our data we can confirm Carhart's statement that speech reception for spondees appears to be more dependent upon sensitivity at 512 and 1,024 cps than at 2 048 cps, since the group of individuals with a steeper slope of the audiogram (i e, with a more marked loss at 2,000 cps) have a smaller hearing loss for speech than can be predicted from the average 500-2,000 The disagreement between pure tones and speech in individuals with almost flat or mildly sloping audiograms is in contrast with Carhart s results This disagreement might be due to age difference, since the subjects in Carhart's population were unselected with respect to age

For this reason, we examined the same relation between the slope of the audiogram and the difference between spondees and pure tones in a group of young individuals Fig 7 shows such a relation Individuals with almost flat or mildly sloping audiograms (slope less than 5 db) show a better correlation between spondees and pure tones than individuals of the old group, pure tones are only from 1 to 2 db better than spondees. Furthermore, in all the individuals with a sloping audiogram (from 5 9 9 to 25 db slope per octave) hearing loss for spondees is smaller than can be predicted from the average pure tones 500 2,000 cps On the other hand, if we correlate loss for spondees with the average loss for pure tones 500 1,000 cps spondees show a greater loss as the slope increases

The comparison of the relation between hearing loss for pure tones and hearing loss for spondees in young and old individuals shows that in young individuals the correlation is better In old individuals, spondees generally show a greater loss than can be predicted from the audiogram This finding is not surprising, since it has already been pointed out how severe discrimination loss is in old people, when tested with PB lists, as compared with discrimination loss in young people with the same amount of hearing loss

Our results suggest that discrimination loss is significant even with easier speech material like the spondee lists As a matter of fact, a careful analysis of the spondee scores in many of our subjects shows that many words were not understood by them even when presented at a level well above threshold In general, a spondee test starts from a level about 20 db above the average pure-tone threshold At this level, normal subjects, subjects with conductive hearing loss, and even most subjects with a perceptive hearing loss understand correctly almost 100 per cent of the words But many of our old patients did not repeat correctly 100 per cent of the words even at the level 20 db above threshold Apparently these old people had such a severe difficulty in understanding speech that it appeared not only in the PB discrimination test, but even contributed to a greater loss for spondees This generalization needs more careful analysis and more extensive study, but if this is true, the concept of "phonemic regression" syndrome receives still greater support and seems to be more strictly confined to the older individuals

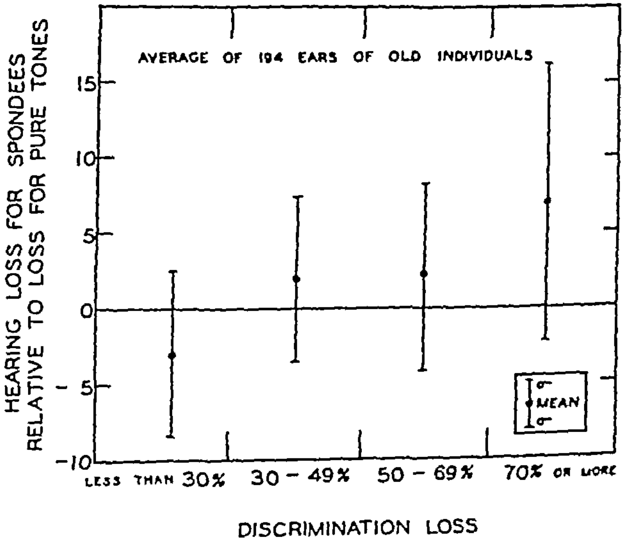

Fig 8 Difference between hearing loss for spondees and for pure tones as a function of discrimination loss for the old group

Fig 8 shows the relation between discrimination loss and the difference between spondee and pure-tone loss (average 500-2,000 cps) Among four "discrimination" groups, the difference between spondee and average pure-tone loss increases as discrimination gets worse In other words, in individuals with good discrimination (loss less than 30 per cent), spondees are 3 db "better" than pure tones, in individuals with discrimination loss from 30 per cent to 49 per cent, and from 50 per cent to 69 percent, pure tones are 2 and 3 db better than spondees, and finally in individuals with very poor discrimination (loss greater than 70 per cent) pure tones are 7 db better than spondees

These findings further support the previous statement concerning "discrimination loss" even for spondees When discrimination is very poor even the threshold for spondees is shifted and there is a lack of agreement with the average hearing loss for pure tones

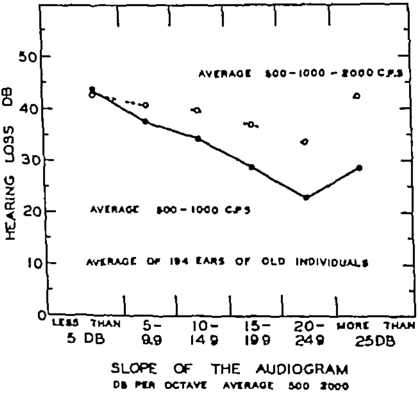

Fig 9 Relation between averaged hearing loss for pure tones and the slope of the audiogram.

Another factor should not be underestimated when comparing the difference between average pure tones and spondee loss as a function of the slope, i e the comparison of the amount of hearing loss for pure tones in groups of individuals with different slopes of the audiogram. Fig 9 shows such a relation It should be noted that, in our group individuals with an almost flat or mildly sloping audiogram have a more severe hearing loss than individuals with steeper slope of the audiogram The difference is more impressive when considering hearing loss for the average pure tones 500-1 000 cps, but it is also present when we consider the average 500-2,000 cps, excluding individuals with more than 25 db slope per octave Since we know that discrimination loss is a function of hearing loss (see Fig 2), it is very likely that the greater difference between pure tone and spondee loss found in individuals with almost flat or mildly sloping audiograms is partially due to the larger overall amount of hearing loss shown by these individuals

In going through our records, we noticed incidentally that it was not always possible to predict the patient's judgment as to how he liked the performance of the hearing aid Some patients were satisfied with their aids while others were not We decided to investigate further to see what factors were associated with this judgment

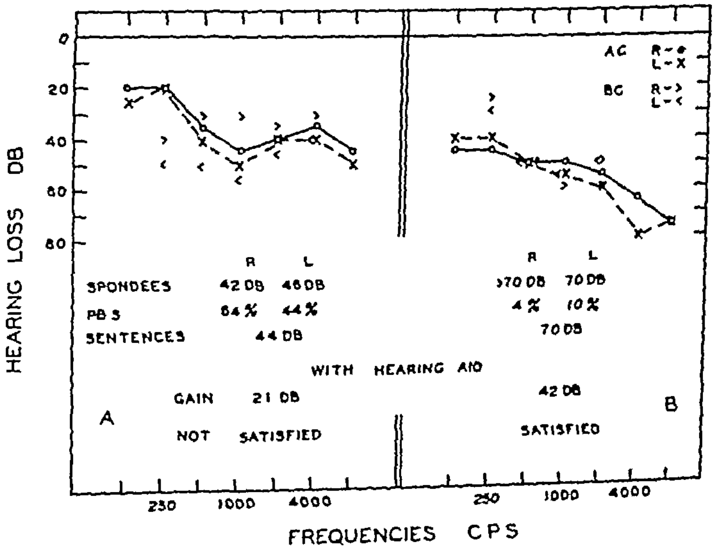

Fig 10 Clinical records of two patients A has moderate loss and moderate discrimination loss and is not satisfied with a low-gain hearing aid, B has a more severe loss with much worse discrimination and reports satisfaction with a high-gain hearing aid.

We assumed that gains obtained with hearing aids while using sentence material would be indicative of satisfaction with the performance of the hearing aid Our results, however, do not warrant this assumption Some patients, although they received good gains, were not satisfied with their instruments We suspected that poor discrimination might be the influencing factor in this discrepancy This, too, did not seem to be true with all cases, since some patients voiced dissatisfaction with their aids even though their discrimination scores were fairly good

It appears that factors other than gains and discrimination enter into the picture The amount of hearing loss may be the deciding factor For example (see Fig 10), a patient with a mild hearing loss and good discrimination *(a)* might not be satisfied with a hearing aid while on the other hand, a person with a more severe hearing loss *(b)* might enjoy wearing an instrument even though his discrimination is very poor

The examples cited above are extreme cases, to be sure and many different combinations of hearing losses, discrimination scores and gains fall in between these two extremes. However, these illustrate that "scores" alone can not be used as a yardstick for predicting whether or not a patient will be satisfied with the performance of his hearing aid Since only a small number of these patients returned for this investigation, we do not have enough information to study the relationship between "scores and satisfaction with an instrument. This relation merits investigation on a larger sample of individuals

Another purpose of our investigation was to ascertain whether recruitment is present in presbycusis cases, and which relations occur between recruitment and discrimination for speech. According to the data of several authors (Huizing and Reyntjes,[18] Dix Hallpike and Hood,[19] Eby and Williams,[20] Hirsh, Palva and Goodman[21]), a low discrimination score at a high intensity level is a fairly reliable indication of recruitment Hirsh, Palva and Goodman state that a low discrimination score will usually predict recruitment, but on the other hand, a high discrimination score does not always predict the absence of recruitment.

The relation between recruitment and discrimination loss in the 24 old patients who returned for re-test is shown in Figs 11 and 12 Fig 11 shows that these patients are a good sample of our population insofar as the relation between hearing loss for pure tones and discrimination loss is concerned, since this relation is approximately the same as in the total group of 185 individuals (see Fig 2) Recruitment results have been plotted in order to attempt a quantitative rather than a qualitative judgment

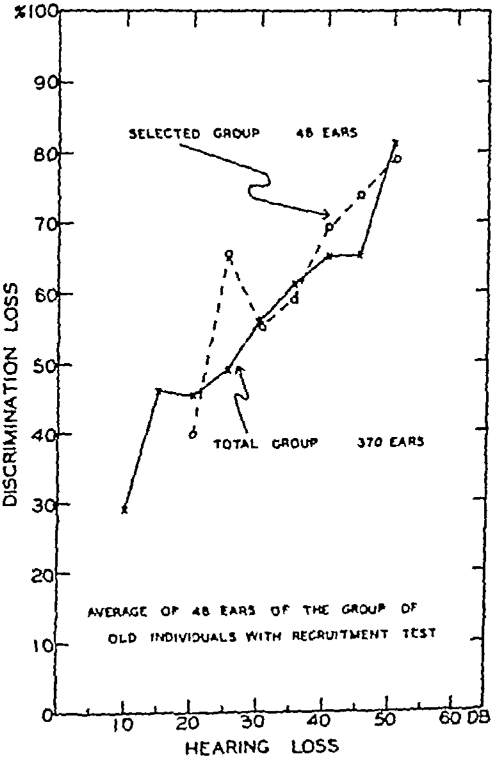

Fig 11 Comparison of the relations between discrimination loss and hearing loss for the total group (185) and for the selected group (24) on whom further tests were made

On the abscissa of Fig 12, 0 db means that the same difference in db between the threshold for the two selected frequencies is still present at the maximum level (60 db or more above threshold) at which the test was performed On the other hand, 10 or 20 db means that at the maximum intensity level, the difference between the two selected frequencies was reduced by 10 or 20 db in respect to threshold level We counted changes less than 5 db as no recruitment, changes between 5 and 30 db as partial recruitment, and changes more than 30 db as almost complete recruitment. According

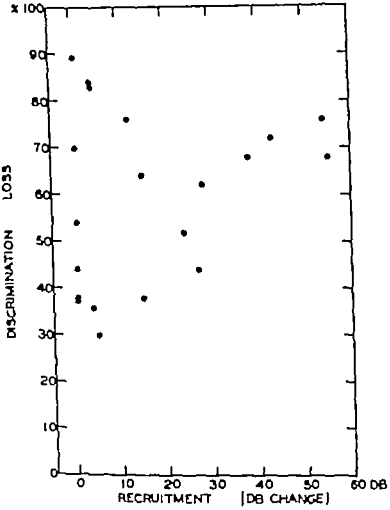

Fig 1.— Relation between discrimination loss and recruitment Discrimination may be good or bad if recruitment is absent but is only bad if recruitment is great

to these criteria the following results were noted Four subjects gave uncertain results one of them because of his difficulty in understanding what kind of judgment was required in the test situation, three of them because their hearing losses were more than 25 db at every frequency, and recruitment may have been present at both frequencies

score. This fact is additional support to the hypothesis of phonemic regression in old individuals The nature of this regression is not yet clear, but many suggestions indicate that its origin is not peripheral. In fact, the absence of recruitment in most of the cases of presbycusis substantiated also by recent papers by Harbert and Sataloff[21] and by Schuknecht,[22] suggests that discrimination score can be affected even by lesions located in parts of the auditory apparatus other than the cochlea In other words, phonemic regression may be present in the absence of any cochlear damage. Furthermore, we know from the histologic studies mentioned above that lesions responsible for hearing loss in old people are more frequently located in the spiral ganglion cells and in the nerve fibers, rather than in the hair cells. Since recruitment is considered to be a phenomenon strictly confined to lesions of the hair cells, it seems reasonable to state that absence of recruitment in most of the cases of presbycusis provides good clinical support for histological findings

A discrimination test alone is not of great diagnostic value in presbycusis cases if not associated with a recruitment test. Since the discrimination score is always very poor, recruitment should be the deciding factor In the few cases that show recruitment in our sampling, we assume that lesions are more extended to the hair cells of the organ of Corti This can be due to the process of aging itself, evolving in a different manner, or to some other reasons not fully explained by the medical history

SUMMARY

The present investigation has been carried out in a group of 185 selected old individuals The relationships between different tests of auditory function gave the following results

1 In old individuals discrimination for speech is very poor even in the presence of a mild hearing loss A parallel investigation in a smaller group of young individuals with the same amount and characteristics of hearing loss as the old individuals showed that young individuals have better discrimination

2 In old individuals a clear relation exists between hearing loss and discrimination loss, discrimination becomes poorer as hearing loss becomes greater

3 No significant relation has been found between slope of the audiogram and discrimination loss

4 The relation between hearing loss and discrimination loss in a sub-group of individuals with positive medical history does not differ significantly from the relation in the total group of old individuals

5 The relation between hearing loss for pure tones, hearing loss for spondees, slope of the audiogram and discrimination loss shows that individuals with a steep slope of the audiogram (more than 20 db per octave) have a smaller hearing loss for spondees than can be predicted from the audiogram (average 500-2,000 cps) with respect to individuals with almost flat or mildly sloping curves Furthermore, in individuals with good discrimination, hearing loss for spondees is a little less than for pure tones (average 500-2,000), whereas in individuals with poor discrimination, hearing loss for spondees is definitely greater than for pure tones

6 Since in a group of young individuals the agreement between hearing loss for pure tones and for spondees is much more precise, these results substantiate the hypothesis that in old individuals a "phonemic-regression" syndrome exists Phonemic regression seems to have a non-peripheral basis

7 In a smaller group of 24 old individuals in which a recruitment test was performed, 50 per cent of the subjects showed no recruitment, 30 per cent partial recruitment, 20 per cent almost complete recruitment The absence of recruitment in most of our cases of presbycusis is in good agreement with those histological findings that indicate spiral ganglion cells and nerve fibers as the most common lesions responsible for hearing loss in presbycusis

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BINAURAL HEARING ANOTHER APPROACH

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The problem of binaural summation at the threshold, or above threshold level has always raised a limited interest among otologists On the contrary physicists, physiologists and psychologists have approached it from many angles since the time of Seebeck[13] (1846) He observed that if the whistle of a siren was led through two tubes to the two ears, it sounded weaker if one of the tubes was obstructed Such empiric observation received further support by the work of Tarchanow[16] (1878), who, using currents produced by an induction coil connected to a telephone, noted that a subthreshold sound in one ear became audible when heard with both ears

Urbanschitsch[17] (1893) confirmed Tarchanow's experiences by demonstrating that the induced voltage necessary to pro duce in a telephone a barely audible sound, needed to be twice as high in monaural hearing as in binaural hearing Most people of that time, however, were convinced on the basis of the authority of Stumpf and Fechner, that there was no real binaural summation of intensity or of loudness but only a sensation of greater clarity and fullness of the sound, furthermore, the summation, if any, was merely physical, the intensity of two tuning forks, one in each ear, being the same as that of both forks in one ear

An excellent review of the studies on this subject has been recently published by Hirsh,[7] and we refer the reader to this article for more detailed information It was not until recently, as pointed out by Hirsh, that the problem of binaural summation was taken again into consideration, using more modern equipment and more reliable testing procedures

The purpose of these new investigations was to put an end to the deadlock to which it had come as a consequence of the

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contrary evidence produced by Stumpf and Fechner on the one hand and Tarchanow and Urbantschitsch on the other

With the exception of some studies of Fletcher and Munson[5] (1933), and of Caussé and Chavasse[3,4] (1942) related to binaural summation of loudness at intensities well above threshold, all recent work on the subject concerns almost exclusively binaural summation at threshold The majority of the observers (Gage[6], 1932, Hughes[10] 1937, Caussé[3] and Chavasse[3,4], 1942, Shaw, Newman and Hirsh[14], 1947, Keys[11] 1947, Hirsh[7,8,9] 1948, Pollack[1], 1948), gave substantial evidence that binaural summation does exist, that it is more than physical in origin, and that at the level of the central nervous system a nearly perfect summation of the stimuli heard by the two ears takes place

The average difference between monaural and binaural thresholds, as observed by these authors, was about 8 db both for pure tones and for speech, however Sivian and White[15] deny that there are any differences between monaural and binaural minimum audible fields which are not due to the greater sensitivity of the better ear

This criticism has proved to be inconsistent by Caussé and Chavasse[4] and later by Hirsh, by a preliminary "equating" of the sensitivity of the two ears, so that they should be functionally equal in binaural or monaural threshold determinations Complete agreement as to the presence, the site and the amount of binaural summation has not yet been reached

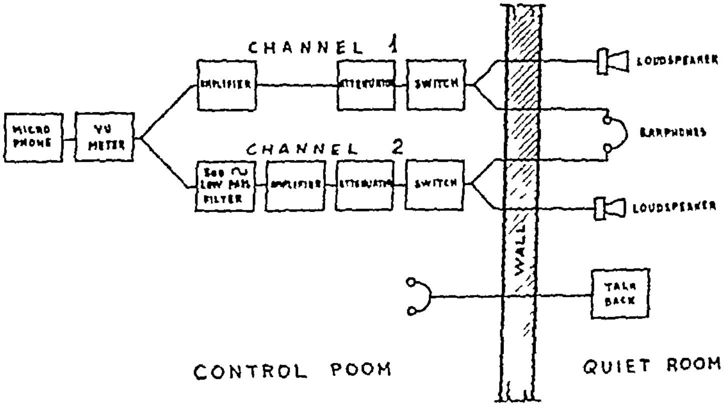
As an otologist, I was not particularly interested in the physical issue, but some fortuitous clinical observations on patients suffering from unilateral deafness persuaded me to try a new approach to the problem of binaural hearing the significance of which, I believe, is no less for the otologist than for the physicist.

APPARATUS AND PROCEDURE.

The apparatus is shown in the block diagram of Fig 1 It has been prepared for the present purpose by the firm, ELIT, of Milano

Fourteen subjects were chosen for the experiment, all with normal hearing in both ears, none of them specially sophisticated in auditory experiments During the test they were isolated in a sound-proof room, and they wrote or spoke the responses according to the speech material used (logotomes or words) The test material consisted of lists of ten mixed logotomes (nonsense bisyllables of Azzi[1]) and of ten meaningful bisyllabic words (phonetically balanced lists of Bocca and Pellegrini[2]) They were spoken by a trained examiner before a microphone connected with the two channels, and the intensity of the voice was monitored by a VU meter

Experiment 1 With the patient sitting in the room and wearing his headphones, the intensity of the voice in Channel 1 was progressively attenuated until a point was reached at which the average articulation score resulting from three determinations did not exceed 30 per cent Subsequently Channel 1 was switched off and Channel 2 was switched on An articulation test was made on the second ear at an intensity of 45 db above threshold (threshold for obvious questions and sentences with filtered voice)



BLOCK DIAGRAM OF THE APPARATUS

FIG 1

With the filter used (500 cps low-pass) articulation score never exceeded 50 per cent At that moment both channels were switched in, and a third binaural articulation test was made Now and again one of the two channels was switched off, in order that the difference between monaural and binaural articulation, if any, might be further checked The test was repeated using words instead of logotomes in another series of subjects In half of the subjects examined the tests were entirely repeated sending the stimuli to the ear opposite to the one tested in the previous experiment.

Experiment 2 After having taken the binaural test, the subject removed his head phones and listened in succession monaurally or binaurally to two loudspeakers, one trasmitting the subthreshold normal voice, the other the suprathreshold distorted voice. Articulation was in no case higher than 50 per cent. Subsequently an articulation test was performed with the two loudspeakers acting together

RESULTS

The results of these experiments are illustrated in Table 1 It can be observed that both for logotomes and words, the discrimination is better when the two stimuli are delivered separately and simultaneously to the two ears Binaural discrimination seems to be fairly equal to the arithmetic addition of the two monaural discriminations, and tends to be even higher for meaningful words

In binaural stimulation the subject supposes he is hearing only suprathreshold stimulation and he is unaware of the presence of the contralateral subthreshold stimulus but for the fact that the voice becomes suddenly "much clearer" when it is introduced

When both stimuli are delivered together to one or to both ears by means of two loudspeakers, there is no effect of summation whatsoever, and the discrimination remains equal to that observed for the suprathreshold distorted stimulus alone

The impression of the voices becoming clearer with consequent better articulation score is reached only when the intensity of the undistorted stimulus is raised at least 20 db below the intensity of the distorted one

LOGOTOMES

CASE	A MONAURAL DISCRIMINATION OF UNDISTORTED VOICE 5 db BELOW THRESHOLD	B MONAURAL DISCRIMINATION FOR DISTORTED VOICE 45 db ABOVE THRESHOLD	C MONAURAL DISCRIMINATION FOR SIMULTANEOUS DELIVERY OF A+B TO THE SAME EAR	D BINAURAL DISCRIMINATION FOR SIMULTANEOUS DELIVERY OF A+B TO THE TWO EARS SEPARATELY
1	30 %	50	50	78
2	25	30	30	57
3	20	47	40	80
4	40	30	30	90
5	15	50	45	80
6	20	20	20	60
7	25	40	50	75
8	20	30	30	70
9	15	50	55	78
AVERAGE	23 %	42 %	40 %	76 %

WORDS

CASE	A	B	C	D
1	30 %	30	30	60
2	25	25	25	55
3	30	20	20	60
4	35	30	30	90
5	20	30	30	60
AVERAGE	28 %	27 %	27 %	65 %

TABLE 1

COMMENTS

We feel that this experimental approach to the study of binaural hearing presents a number of advantages

1 The problem of "equating" the sensitivity of the two ears is eliminated, the only problem to be solved is to choose a sufficiently low intensity of one stimulus and a sufficiently efficient filtering of the other stimulus in order that discrimination for each of them does not exceed 50 per cent, and the effect of summation may be observed in the binaural experiment.

2 The difficulty arising from any pure tone threshold determination is also eliminated by taking, as we did, as an element of judgment, not the difference in attenuation but the difference in speech discrimination score between monaural and binaural listening at levels above threshold

3 There is evidence that the summation exists and may be considered as central in origin, as we are no longer dealing with sensitivity only, but also with discrimination The summation effect is of nearly the same magnitude as that observed by other investigators, although using different experimental methods, *i e*, binaural hearing is the addition of the two monaural hearings

4 There is no question of monaural summation, as the louder stimulus behaves exactly as a masking stimulus when delivered to the same ear together with the weaker one To the summation phenomena observed in these experiments we would better reserve the name of binaural integration, as one ear provides power and the other provides quality

5 The observed phenomena may help in the explanation of some unexpected good results when fitting a hearing aid on the worse ear in bilateral deafness If the aided ear does not reach 100 per cent articulation, due to cochlear damage or to poor quality of the aid, it will be enough that in ordinary conversation subthreshold undistorted stimuli are transmitted by the other ear to insure a higher overall discrimination by the mechanism of binaural integration thus exceeding the results anticipated in the course of the test

6 The test described may be of practical application to examine the efficiency of the central mechanism of hearing, even when hearing is neither normal nor equal in both ears

SUMMARY

An approach has been made to the study of binaural hearing by using speech as a test material The words spoken by the examiner are delivered through two independent channels to the two ears of the subject Channel 1 provides attenuation, Channel 2 attenuation plus 500 cps low-pass filtering The intensity at the output of Channel 1 is adjusted each time at a level where no more than 40 per cent discrimination score is attained in repeated tests The filter in Channel 2 does not allow more than 50 per cent discrimination score when the stimulus is presented at 45 db above threshold If the two stimuli are presented simultaneously, one to each ear of the subject, discrimination score becomes much higher, and reaches a per cent value which is approximately equal to the addition of the two monaural discrimination scores The experiment provides evidence of binaural summation and binaural integration

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MIDWINTER SEMINAR IN OPHTHALMOLOGY AND OTOLARYNGOLOGY

The Tenth Annual University of Florida Midwinter Seminar in Ophthalmology and Otolaryngology will be held at the Sans Souci Hotel Miami Beach, the week of January 16, 1956 The lectures on Ophthalmology will be presented on January 16 17 and 18, and those on Otolaryngology, January 19 20 and 21 A midweek feature will be the Midwinter Convention of the Florida Society of Ophthalmology and Otolaryngology on Wednesday afternoon January 18, to which all registrants are invited. The registrants and their wives may also attend the informal banquet at 8 p m Wednesday The schedule has been changed to provide a maximum time for recreation each afternoon

The Seminar lecturers on Ophthalmology this year are Drs Francis H Adler, Philadelphia, A Gerard DeVoe, New York, Michael J Hogan San Francisco, C Wilbur Rucker, Rochester Minn and A. D Ruedmann Detroit, Mich. Those lecturing on Otolaryngology are Drs Frederick A Figi Rochester Minn Lewis F Morrison San Francisco Charles E Kinney Cleveland John R Lindsay, Chicago, and Bernard J McMahon St. Louis

THE MODERN CONCEPT OF SURGICAL CORRECTION OF PROTRUDING EARS *

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INTRODUCTION

With some 30 to 40 articles in the current literature on correction of protruding ears, one might assume that no single satisfactory technique has yet been advanced. Definitely constructive trends, however, are evident in recent years. The purpose of this dissertation is to correlate, reaffirm and emphasize these and to suggest certain possible refinements.

Protruding ears constitute the most common deformity of the auricle. This fact is attested by most writers on the subject, and Becker,[5] Luckett,[22] and May[23] particularly stress it. It is also generally understood that the deformity is especially important psychologically, whether the patient be a child or an adult. The reference to "flop ears," "elephant ears," "sail ears," "donkey ears" or "Dumbo ears" is a source of constant concern to the afflicted. Children may suffer personality changes when they reach school age and are constantly ridiculed by their new-found friends and classmates. Corrective surgery may be performed at age five or six years without adverse effect on future growth. Adults often find difficulty in employment and generally in mixing with the public at large. This is one deformity which provokes laughter instead of pity, and it should be obvious that a good method of correction is important.

Otolaryngologists see more ears at close range than any other group in medical practice. They are, therefore, obliged to be equipped for correcting this most common deformity of an organ which they know from inside out, from embryo

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* Submitted as Candidate's Thesis to American Laryngological, Rhinological and Otological Society, Inc., 1955.

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to old age. They should think no more of it than an orthopedist's correction of a "club foot," an ophthalmologist's correction of a ptosed eyelid or a urologist's correction of an hypospadias

REVIEW OF LITERATURE

The profession is greatly indebted to Becker[4] who gave a review and analysis of the literature up to 1949 along with description of the technique he used, however, there were several articles[1,2,9,11,16,23,30] with publication dates prior to that mentioned, which were not included in the review Reference will be made to some of these Of particular interest is a presentation by Seeley,[31] mentioned by Becker, dated 1946 This embodied a technique somewhat similar to that described by Becker and like his, represented improvements in the then "standard" technique

The problem of outstanding ears was recognized and written about as early as 1845 by Dieffenbach[13] His operation advised removal of skin from the back of the ear and suturing of the ear cartilage to the mastoid periosteum A succession of surgeons wrote further from 1881 to 1903 These were Ely,[14] Keen,[20] Monks,[23] Joseph,[19] and Morestin[24] They removed skin from the junction of the ear with the mastoid as well as a segment of the conchal cartilage and then sutured the skin edges This procedure must have corrected the deformity temporarily but not permanently

Because still another type of otoplasty was suggested in 1910 by Luckett.[22] He set forth the premise, still held today that the deformity in outstanding ears is due to the lack of an anthelix To correct this condition, he used excision of an ellipse of cartilage and skin along the line of the new anthelix from the posterior surface of the ear In closing he used an everting mattress suture to roll the cartilage edges forward before closing the skin

There followed in 1937 an article by Davis and Kitlowski[12] outlining a modification of Luckett's procedure The approach was still to remove a large segment of skin from the mastoid and posterior surface of the ear and to remove an ellipse of cartilage They added an incision along the inferior crus of the anthelix and still utilized the buried everting mattress suture through the cartilage edges Becker[2] voiced the objection that by removal of cartilage only from the inferior crus, the superior crus may appear flat and frequently allow the ear to fall forward at its upper pole

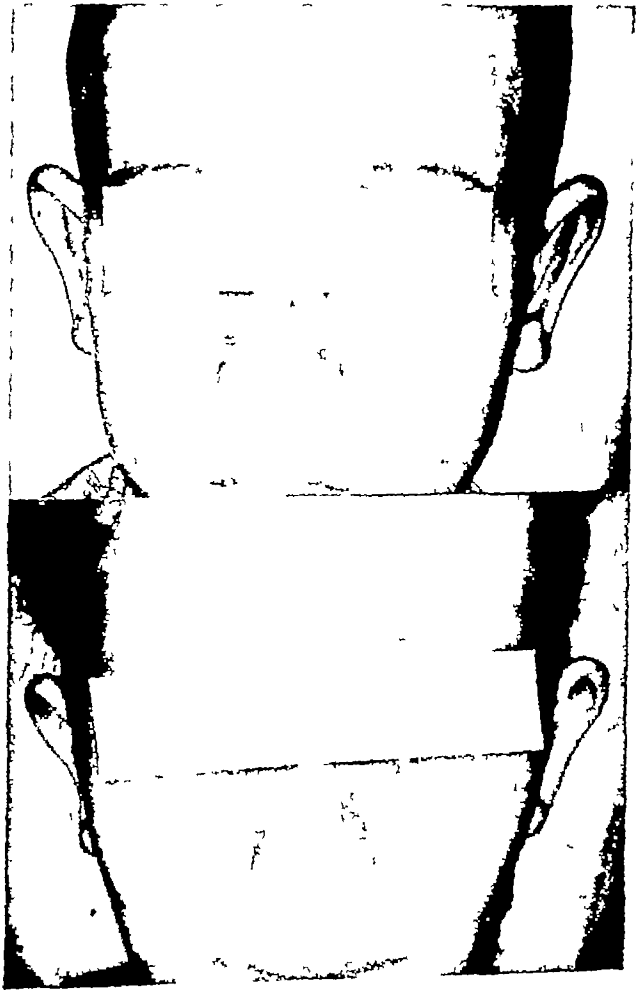

Fig 1 Unsatisfactory results obtained by the author utilizing the technique of removal of ellipse of cartilage and skin from posterior surface of the auricle to correct protruding ears The patients were happy but the ears lop forward from the upper pole and are plastered to the head at the lower pole

New and Erich[27] (1940) added the next innovation in the form of external mattress sutures to hold the new antihelix in position while healing occurred Their operation continued removal of an ellipse of cartilage to form the new antihelix Segments were removed from superior and inferior crura

With only minor differences, this technique of removal of an ellipse of cartilage and skin from the posterior surface of the ear to form a new antihelix and the application of some form of stay sutures continued for some years It was extolled by Cox,[11] Baxter,[1] Berson,[2] Seltzer[32] Weaver,[35] May,[23] Franklyn,[14] Rosedale,[30] Brown,[9] and Pick[29] (who removed cartilage and anterior plus posterior skin surfaces) during the 1940 s Continuing past 1950 with the same procedure advised, were Leonardo[21] (1950), Jayes[18] (1952) and in his text on Plastic Surgery (1950) Ferris Smith[33]

Although some surgeons still use this procedure, it has definite shortcomings Becker[5] stated the following objections That the normal postauricular sulcus is obliterated by excess removal of skin the superior crus may appear flat (if no cartilage is removed from it) and the upper pole of the ear may lop forward and a sharp unnatural ridge is left on the surface of the auricle Seeley,[31] (1946), Vidaurre[34] (1952) and Gonzales[17] (1952) found similar objections since they advocated a departure from the then "standard" technique The author has likewise found the technique unsatisfactory in his experience Fig 1 indicates how although the ears are set back (and the patient thus made happy), there is a "dogging" from the upper pole The auricle is plastered against the head by obliteration of the sulcus between the ear and the mastoid

One might question "Why bother to improve a technique which sets back the outstanding ears and thus satisfies the patient?' Cox[11] stated specifically that "my patients repeatedly told me after operation that what they want is that the ears should be fixed at the proper angle and not 'stick-out' from the head They do not object if the folds and contour of the pinna are not exactly the same as before" It is axiomatic that the more perfectly a restorative operation can approach normal anatomy the better A conscientious present day surgeon is not satisfied with a result in which there are unnaturally sharp ridges, the pinna lops forward above, and the back of the ear is plastered to the head

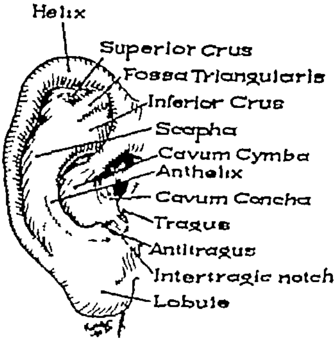

Fig 2 External Anatomy of the Right Ear Lateral View

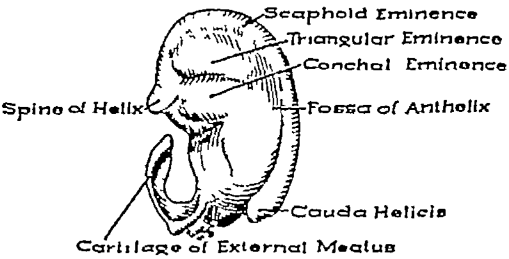

Fig 3 Landmarks of Auricular Cartilage Right Ear Posterior View

Several modifications have been advanced to get around these defections Reference is made first to Figs 2 and 3, which review some of the anatomical terms applicable to the external ear One should recall that there is normally an angle of approximately 30 degrees at the upper pole between the pinna and the side of the head The improvements suggested by Seeley,[31] Becker,[4,5,6] Vidaurre,[34] and Gonzales[17] will be considered

Seeley[31] (1946) advised a double "Y" approach The posterior skin was marked with methylene blue by folding the ear into the desired position The double "Y" was marked with the long limbs joining The fork of the upper "Y" was made by the fossa triangularis and the new anthelix crura The fork of the lower "Y" was made from the base of the intertragic notch anteriorly toward the cavum concha and posteriorly toward the antitragus. This double "Y" incision leaves three triangles of cartilage after skin elevation. Thin "arrow-head" segments of cartilage and skin were then trimmed so that the ear would lie back. Illustrations accompanying the article indicate good results with final contours approximating a normal ear The author was not so fortunate, as indicated by Fig 4

Becker's[4,5,6] somewhat similar technique (1949-1952) was also described to set the ears back, to avoid lopping forward at the upper pole and to avoid sharp ridges except where they appear normally He utilized the following skin incision starting on the posterior auricular surface near the attachment to the mastoid area swinging laterally and then downward parallel to the helix, thence back toward the mastoid attachment. After elevation, this exposed all the posterior auricular anatomy, a point Becker justly considers important Proposed new anthelix and roll of the helix were marked with needle punctures from the anterior surface Incision of cartilage included the new anthelix, its inferior crus, and a peripheral incision to insure roll of the helix forward The superior crus area was cross cut to break the spring A diamond shaped wedge of cartilage was removed as needed from the anthelix and cymba An appropriate piece of post auricular skin was removed

Two other features he mentioned seem to be of utmost importance. The cauda helicis must be removed in most cases A "sliver" of cartilage parallel to the upper helix rim must be removed to avoid the "dogging" forward of the upper pole External stay sutures were applied and a small drain left in the lower end of the sutured skin incision Fig 4 would indicate that in the author's hands, the principles described by Seeley and Becker are not entirely satisfactory Although the patient is happy, the ear has a plastered, unnatural appearance. Possibly the inadequacy lies in lack of proper interpretation or application of the techniques

Vidaurre's[44] (1952) approach was again similar to Becker's up to the point of closure Instead of using the New and

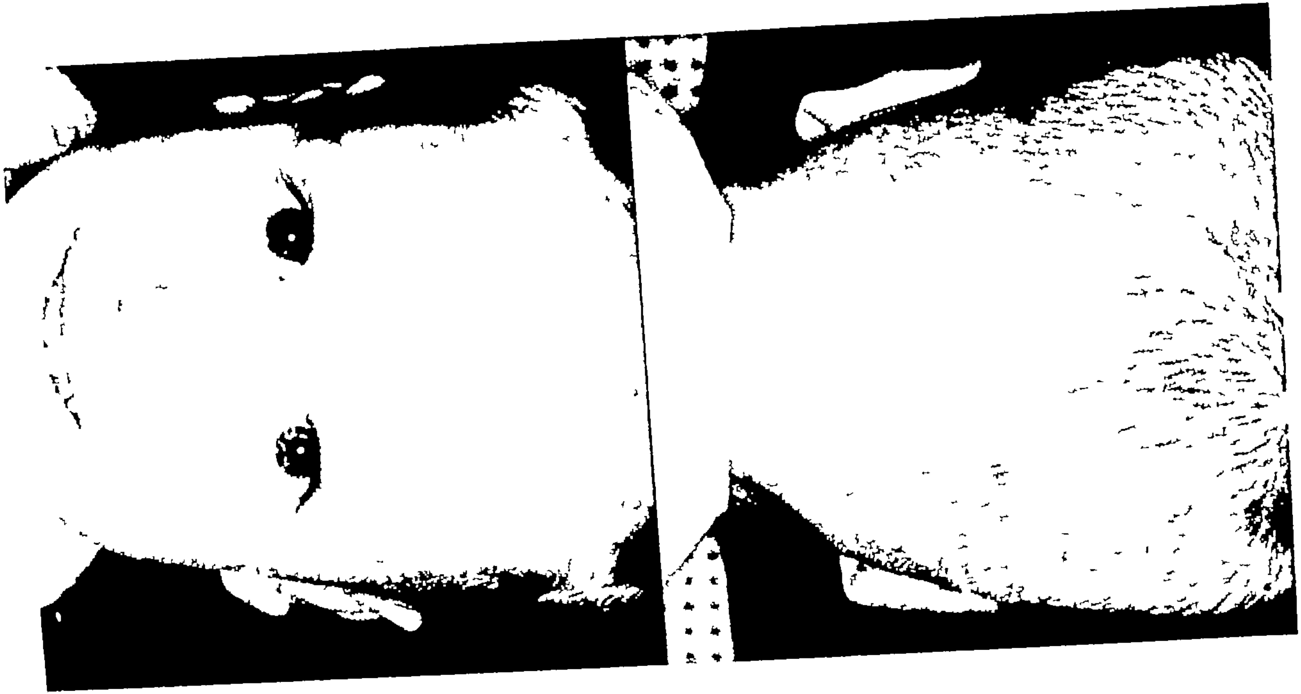

Fig 4A

Figs 4—A B Four post operative views of result satisfactory to patient but unsatisfactory to the author In attempt to follow principles outlined by Seeley[31] and Becker[4] to set back outstanding ears Note plastered effect and sharp superior crus of anthelix The protruding ear looks over-corrected (Possibly the inadequacy lies in lack of proper interpretation or application of the technique)

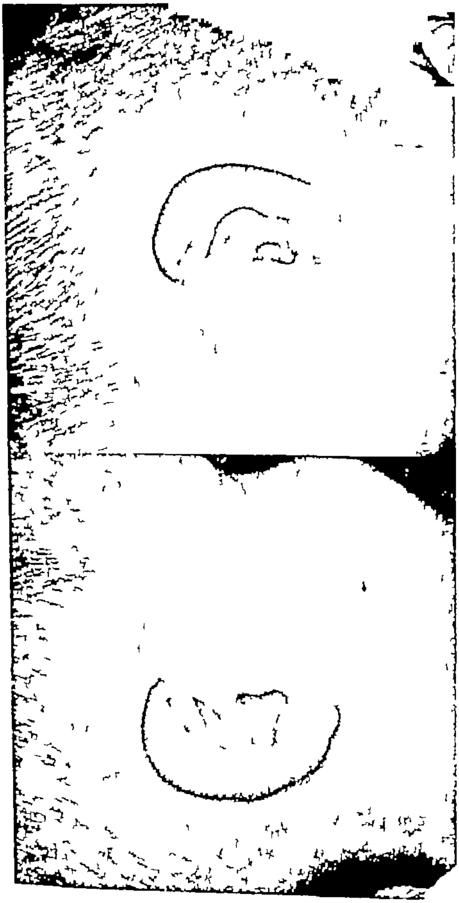

Fig 4B.

Erich[27] external stay sutures, he employed a type of imbrication sutures After undermining anterior and posterior skin about the concha and removal of a cartilage section, the external segment was pulled and sutured over the medial segment in a sort of imbrication He emphasized that the amount of cartilage removed was very important too much makes the ear flat against the head, too little leaves a sharp anthelix

Gonzales[17] (1952) reported an entirely different idea On the anterior surface of the ear a five millimeter incision was made in the middle of and parallel to the anthelix The skin was elevated through it along the new superior crus and fossa triangularis Incision of the cartilage allowed elevation of the posterior skin At this point small scissors were introduced and the cartilage incision extended to include the new anthelix, both the superior and the inferior crura The small cutaneous wound was closed and filiform wire sutures utilized to hold the ear in the new position According to pictures demonstrating the technique, there seemed to be two disadvantages first, there appeared to be a sharp edge for the new anthelix crura, second, there was a tendency for the superior pole to lop forward (no incision made parallel to the helix as Becker described)

These in general are the modifications set forth by modern surgeons to correct the shortcomings of the Davis and Kitlowski,[12] and New and Erich[27] technique Various small details have not been included, but the essential basis described The chief features in common, except in the case of Gonzales, are these incision of cartilage through the new anthelix is necessary, a segment of cartilage whether diamond-shaped or arrowhead-shaped must be removed from the cymba, some form of stay sutures are applicable whether through and through external or buried for imbrication In addition, incision or even removal of a "sliver" parallel to the helix at its upper pole is advisable to prevent lopping forward of the upper pole As will be seen, the author's experience would indicate these principles in general are sound

One other question deserves discussion before proceeding to a description of detailed technique presently used by the author That is, how to avoid a sharp, unnatural ridge at the superior crus of the anthelix The concensus seems to be that some form of cartilage thinning of the area as opposed to complete incision or removal of cartilage is advisable

Pierce, Klabunde and Bergerson[29] (1947) found consistent sharp edges resulting from the removal of an ellipse of skin and cartilage from behind the ear This was particularly evident in the area of the new superior crus fold They stated

> Our first efforts to reproduce this fold were failures, a thinning of the cartilage from behind, but the thinning produced only another ridge * Then came crosshatching, better, but still not satisfactory Finally the use of eight or ten parallel incisions almost through the cartilage in the line of the desired fold gave quite an accurate representation of the normal fold "

On this point a contrary view was held by Ferris Smith[31] (1950) who still advocated removal of an ellipse of cartilage to make the new anthelix where mere incision would not suffice He stated "It is neither necessary to thin and bend, nor to make multiple parallel incisions ('lobster tailing') at intervals of 1 or 2 mm along the antihelix line to produce the desired rounded edge of the new antihelix. The latter frequently suffers scar contractions and irregularities "

Becker[4,5,6,7] (1952) and Borges[8] (1953), however, agree with the concept of thinning or crosshatching the superior crus It would seem, then, that their later agreement with Pierce et al [29] indicates this to be a desirable refinement of technique. The author's experience would confirm this general principle.

Becker feels that cross cutting the superior crus by incisions partially through the cartilage weakens the spring to give a final smooth contour, in fact, even the cross cutting may not be necessary in some children where the cartilage is weak

Borges gets the rounded contour of the anthelix by incising and criss-crossing it instead of removal of a segment

It will be noted that the author prefers the uniform, better controlled thinning of the superior crus possible by using the motor driven dental burr

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Could this be because the thinning was not uniform unlike one might obtain, for instance with a dental burr?

SURGICAL TECHNIQUE

It should be stated at the outset that the author makes no claims of originality for the technique to be described By trial and error it has been found to work best in his hands As noted in Fig 1, the older technique of removal of ellipse of cartilage and posterior skin was unsatisfactory Fig 4 would indicate still something to be desired by adherence to Seeley's and Becker's techniques *per se* in the author's experience, granted that some lack of success might be related to difference in surgical judgment, misunderstanding or misapplication of principles laid down, etc Suffice it to say that the technique to be described gives consistently good results when applied by the author Every surgeon should find such a satisfactory one for himself and stick to it, so long as sound principles are applied As will be noted, the technique utilizes certain facets of procedure from Seeley, Becker, Vidaurre, Pierce, et al, with a background of some of the earlier surgeons It was suggested[10] that a motor driven dental burr might work well for thinning the superior crus of the antihelix to give a more natural roll This has been tried and found useful So far as can be ascertained at present, no one has reported experience with this minor modification to date

Details of the modern concept of surgical correction of outstanding ears are as follows Pre-operative pictures are made in all cases, as well as post-operative pictures The advisability of this practice is obvious Unlike the situation with respect to nasal plastics, pre-operative models of the ears (Brown[9]) are not considered necessary The hair is shaved one-half inch around each ear Surgical preparation of the skin of the ear and adjacent areas is carried out with suitable antiseptic agents, such as Phisoderm and Zepharin The anesthesia may be either local or general depending upon the situation, but injection is made in all cases The solution used is 1 per cent Novocaine with 5 minims of 1 1000 adrenalin and 150 units of Hyaluronidase per ounce It has been found helpful from the standpoint of hemostasis, anesthesia and facility of dissection, to inject both anterior and posterior surfaces of the ear

The posterior skin incision is made in the form of a "U" with the base of the resulting flap medialward at the mastoid attachment and the limbs of the "U" roughly parallel to the free edge of the auricle It has not been found necessary to reflect perichondrium with the skin Hemostasis is secured, though with the above mentioned injection, bleeding is almost nil

At this point, the ear is folded back into the new position and punctures with a hypo needle made from anterior to posterior surface The tip is touched with methylene blue and the needle withdrawn, thus one marks the posterior raw surface and the entire thickness of the cartilage but does not tattoo the posterior skin which has already been reflected The marking should include the new anthelix, superior and inferior crura, the section to be removed parallel to the upper helix rim (to prevent "dogging" forward), and finally the points of forward folding of the helix rim in cases where this is flat. The average case would look somewhat like Fig 5, from behind

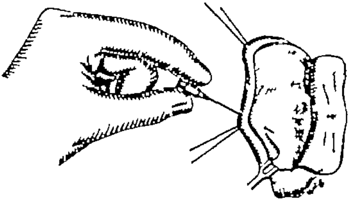

Fig 5. Modified from Becker posterior view of left ear with skin reflected, needle punctures being made to outline areas of incision and thinning of cartilage

The cartilage is cut through with a sharp "plastic" blade along the marked area except in the area of the superior crus of the anthelix. Finger tips of the opposite hand follow along the anterior surface to avoid cutting anterior skin A segment of cartilage is removed from the cymba as indicated and discarded (This cartilage has not been found suitable for use in the nasal cartilage bank) The cauda helicis is removed in all cases. In many cases part or all of the antitragus must be removed to avoid undue protrusion of the lower pole of the ear

In making the gentle roll of the new superior crus of the antihelix a large dental cutting burr is used for even, well controlled thinning of the area The otologist, used to the motor driven burr for delicate dissection in mastoid and fenestration surgery, can utilize this instrument for thinning cartilage to any desired resilience at any point Practice burr dissection on cadaver ear cartilage is deceiving The burr thins live cartilage much more readily An olive-shaped burr was tried but found less satisfactory than the large round cutting burr While the opposite hand follows along the anterior skin, the cartilage is thinned from behind with the burr along the line of the new superior crus An assistant drips cool normal saline on the burr to avoid overheating the cartilage (This is more susceptible to the burr heat generated than is bone) If the thinning is done along a narrow line, an anterior sharp edge will result If it is done uniformly, wide enough to simulate the gentle curve of the normal an-

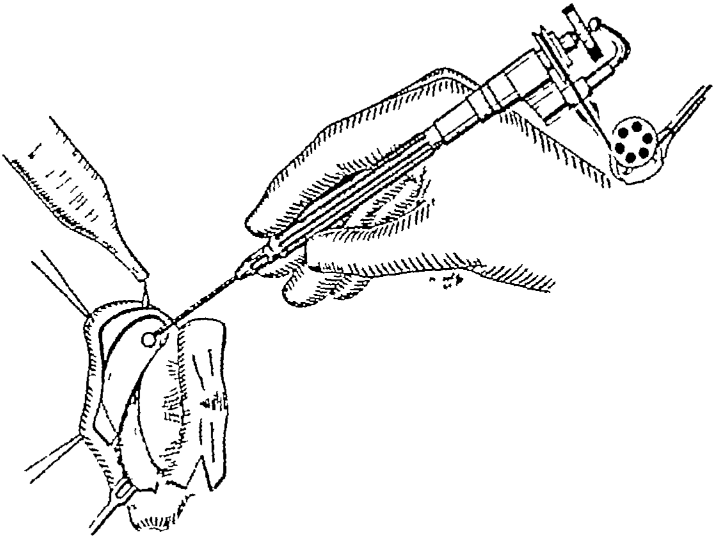

Fig 6 Modified from Becker[8] posterior view of dissection of left ear indicating use of motor driven burr cooled with saline to thin cartilage in area of new anthelix Sliver of cartilage has been removed above parallel to helix rim and cartilage removed from area of concha Cauda helicis and antitragus have been removed Excess skin removal will be along line of "V" in reflected skin flap at right.

thelix, a satisfactory result will be obtained No case to date has "suffered scar contractions and irregularities" for which Ferris Smith[23] denounced the principle of thinning this area (see Fig 6)

Following these steps, redundant skin is trimmed away before closing A word of caution too generous removal of skin may imperil blood supply for healing by overly taut closure, also removal of too much skin tends to "plaster" the ear against the head when proper cartilage work has been done True, undermining of mastoid skin could be utilized, but this should never be required by removal of too much skin

The final step in the operation is the suturing If the lower pole of the ear still tends to lop forward and/or upward after removal of the cauda helicis and the antitragus, a buried suture may be utilized to pull it downward and backward It has been found expedient to insert the through and through external mattress sutures at this point before closure The method of New and Erich[27] whereby the sutures are tied over a cotton roll is utilized, however, it is simpler to use a small roll of one-half inch "New Gauze" plain, since it does not fray or 'bunch up' Care should be exercised in tightening these mattress sutures to just the right point If the above technique has been employed, the ear is apt to stay put in the position in which it is tied One should be sure the 30 degree angle is present at the upper pole and that the ear is not "plastered' to the head

A one-fourth inch flat rubber drain is inserted to prevent hematoma formation The skin edges are approximated by fine interrupted silk sutures and the drain allowed to extend from the lower edge of the wound Cotton pledgets soaked in mineral oil are utilized to fill in the ear contours anteriorly and posteriorly A sterile dressing of 'fluffed" 4 x 4's, two-inch roller bandage and/or 'ace" elastic bandage is applied after the second ear has been operated (While the second ear is operated the first one is dressed loosely and the head laid downward with the ear in a 'do-nut" inflated rubber ring) The routine use of a suitable antibiotic is justified Perichondritis may well ruin the final result, as well as increase morbidity

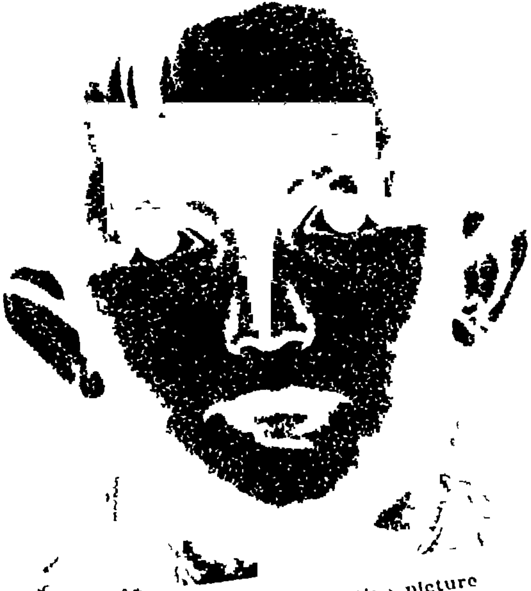

Fig 7A Pre-operative picture

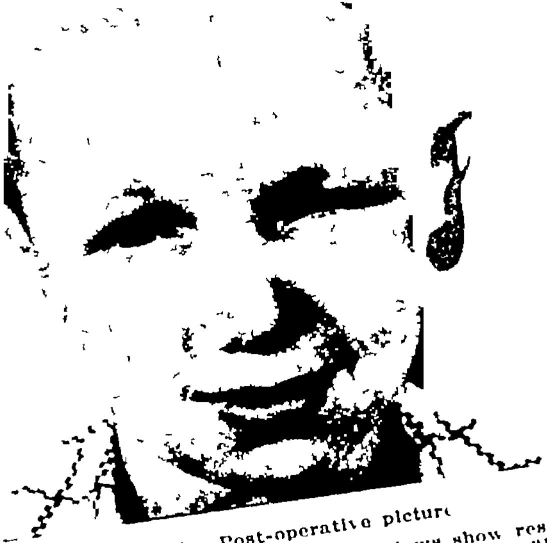

Fig 7C Post-operative picture

Figs 7—A-B C Pre-operative (left hand pictures) and post-operative (right hand pictures) views show results satisfactory to patient and surgeon using technique described The outstanding ears are set back a 30 degree angle to the upper pole is restored and the contours approach normal

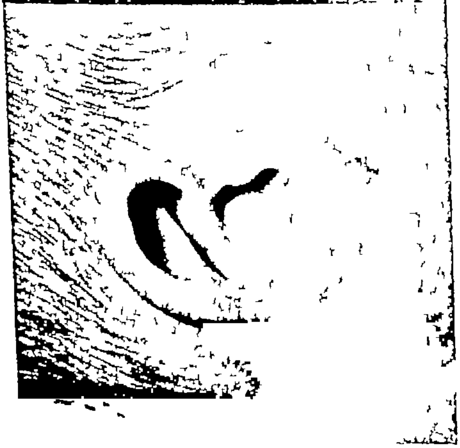

Fig. 7B. Pre-operative picture.

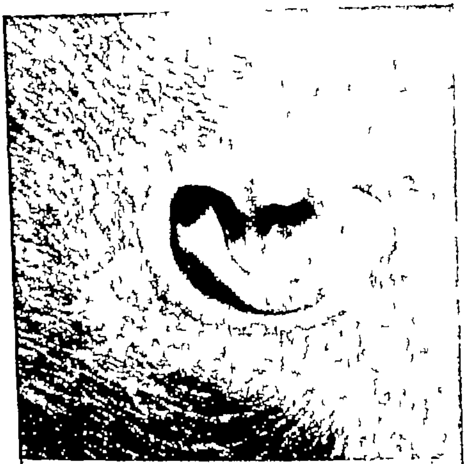

Fig. 7B. Post operative picture

Fig 7C Pre-operative picture

Fig. 7C. Post-operative picture

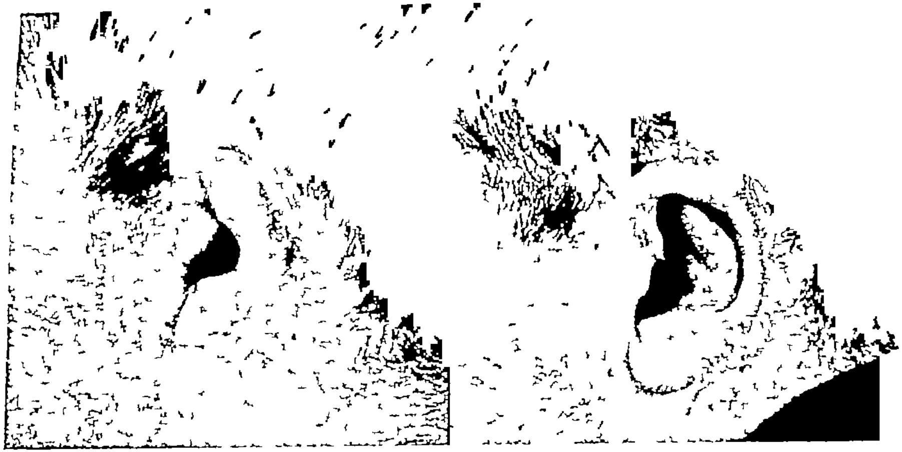

Fig 8 Pre operative picture.

Fig 8 Post operative picture.

Fig 8 Pre operative (left hand picture) and post operative (right hand picture) views of satisfactory result obtained by the technique described. Note the gentle roll of the superior crus of the new anthelix obtained by thinning with the motor driven burr

The dressing is not disturbed till the third post-operative day, unless the patient complains bitterly of pain, in which case the dressing is removed at once and the ears inspected for hematoma, pressure points, etc Otherwise the drains are removed on the third day and the ears redressed The sutures are removed on the fifth to seventh day No pressure or elastic head band is required after the sutures are removed If the operation has been done properly, the ears will "stay put" Figs 7 and 8 show results of this procedure—satisfactory to the patient and surgeon The ears are set back, a 30 degree angle to the upper pole is restored and the contours approach normal

SUMMARY AND COMMENT

Protruding ears constitute the most common deformity of the auricle Since the days of 1845 when Dieffenbach[13] advised removal of skin from the back of the ear and suturing the ear cartilage to the mastoid periosteum for correction of protruding ears, numerous articles have been written Advancement of techniques has progressed through definite steps Next came removal of skin from the sulcus and adjacent cartilage before suturing

Luckett[22] first recognized that the deformity in outstanding ears is due to the lack of an antihelix His surgical correction consisted of excision of an ellipse of skin and cartilage to form a new antihelix Everting mattress sutures (buried) were utilized This technique (except for minor changes) with addition of external mattress sutures by New and Erich[*] was standard from 1937 until 1946

In that year Seeley[31] described a double "Y" approach with his incisions which attempted an ear with normal contour and the proper "setting back" Becker's[4] somewhat similar technique in 1949 utilized a diamond-shaped removal of cartilage An important addition was removal of a "sliver" of cartilage parallel to the upper helix rim to prevent lopping forward Vidaurre's[34] solution of the problem in 1952 was similar to the latter two, except in addition he imbricated the cut cartilage medially over the conchal area to reestablish normal contour Gonzales[17] in the same year made a complete departure by incision of the anterior skin and cutting new antihelix folds in the cartilage. Pierce, et al ,[19] Becker,[4,5,6,7] and Borges[8] utilized thinning, or crosshatching, the superior crus of the antihelix to insure a natural roll A sharp edge too often results from incision or removal of cartilage here

The author finds successful results (a set back ear without sharp edges or helix lopping forward, and a natural appearing contour) by combining some operative features of Seeley,[21] Becker,[4] Vidaurre,[24] and Converse[10] To insure uniform thinning of the superior crus of the antihelix a motor-driven burr is employed

CONCLUSION

Otolaryngologists, who see more ears at close range than any other group in medical practice, should be equipped to correct the most common external ear deformity—the protruding ear The modern concept of surgical correction embodies more than removal of an ellipse of cartilage and employment of stay sutures It establishes an ear set back, with a normal contour, no unnaturally sharp ridges and no lopping forward of the upper helix rim, it includes several incisions of cartilage, removal of segments and a uniform thinning of the superior crus of the new antihelix with a motor-driven burr

Acknowledgments The author acknowledges with thanks Dr Oscar J Becker's permission to modify and redraw some of his figures, as indicated To Mr Dick Mathias of Baylor University College of Medicine the author is grateful for the medical drawings Two of the photographs (see Fig 8) were reproduced from print made by the Veterans Administration Hospital Houston, Texas, Department of Medical Photography

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5 30 P M—*Clinical Conferences

6 30 P M—Dinner, Parkland Hospital Dining Room

7 30 P M—Program

Parkland Hospital, Rooms 101-102

Fixation of Facial Fractures Using the Kirschner Wire

Dr Herbert H Harris, Houston, Texas

8 00 P M—Technique of Cataract Extraction

Dr Tullos O Coston, Oklahoma City, Okla

*Clinical Conferences at 5 30 P M, Parkland Hospital, E N T Room 103—Eye Room 104

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